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FATHER ANGELO SECCHI.

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A century ago, on June 29, 1818, there was born at Reggio in AEmilia, Italy, a child that was destined to become one of the greatest astronomers of his age. He was to open up new avenues of research and to be the founder of important branches of science. In his person religion and science were happily blended. Both as a Jesuit and as an astronomer, his character has ever been undimmed and unimpeached. It is a pleasure, then, and a privilege to write his eulogy, and to narrate his achievements.

FATHER ANGELO SECCHI

Little or nothing is known of Father Secchi's childhood. That it was passed in innocence and integrity is shown by the fact that on November 3, 1833, only four months beyond the minimum age of fifteen years that its constitutions permitted he entered the Jesuit order. He passed successfully through his three years of probation, two of literature, three of philosophy and science, and four of theology, and was raised to the dignity of the priesthood at the usual time.

He early disclosed his predilection and his talents for the sciences in which he was to achieve his renown. He was accordingly appointed to teach mathematics at Rome in the College of Nobles, and then at the Roman College. Later he taught physics at Loretto, and after this was an assistant to Father DeVico in the observatory of the Roman College, the first that the Jesuits were able to establish since the restoration of their order in 1814. Great as was the reputation of the master, the pupil was soon to eclipse him in the same science and in the same place.

The revolution of 1848 seemed to nip all these fair prospects in the bud. The Jesuits had to flee from Rome. DeVico went to France, and

then to Georgetown College, in Washington, D. C., whither Secchi soon followed him. Here the latter taught physics for a year and made original discoveries in electricity.

When the revolution subsided in the following year, Father Secchi was recalled to Rome, and, as DeVico had died in the previous November, he was appointed director of the Roman College Observatory. At the early age of thirty-one years Angelo Secchi now entered upon the career for which his talents and his industry so admirably qualified him, and quickly became one of the foremost scientists of his age.

His first care was to build a proper observatory and to furnish it with suitable instruments. With means liberally supplied by Pius IX and the Society of Jesus, he in 1853 transferred the existing observatory to the place his predecessors had selected, and built it upon the east and south walls of the college and upon the principal pilasters of the church of St. Ignatius. His main instrument was a nine-inch equatorial telescope. While this would be considered nowadays quite an ordinary size for the student's observatory of a university, and no match for our modern giants, still in its day it was one of the great telescopes of the world. But it was directed by a genius of the first order, who well knew how to use it, and who did use it with an energy that never felt fatigue. To look at his published reports and articles and books, one would imagine he used it day and night continuously without ever stopping to rest. No class of heavenly bodies escaped his scrutiny, the sun, the moon, the individual planets, comets, and thousands of stars, were observed with an assiduity and an accuracy that seemed to make each one the pet object of his research.

Father Secchi's work on the sun and the stars will be remembered as long as the science of astronomy will endure, for he was one of the great pioneers, one of the great founders of a new branch of astronomy. He was one of the very first to apply the newly invented spectroscope to the heavenly bodies, and to see its possibilities and the enormous harvest of knowledge it would yield. He was also quick to see the soul of the new instrument, and to design various types of spectroscopes. One has but to open a recent and authoritative treatise on the subject, such as *Scheiner's Astronomical Spectroscopy* by E. B. Frost, now and for some time director of the Yerkes Observatory, in order to see how Secchi's ideas are still embodied in our present day instruments.

One of the forms with which he did a great part of his work on stellar spectra, and which is "described and illustrated in all text books on spectrum analysis" (Frost, page 29) is called the objective-prism spectroscope. Here the prism is a large one and is placed outside and in front of the objective of the telescope, thus utilizing to advantage the full focal length of the tube.

In the second form "devised by Secchi" (Frost p. 30) the prism or system of prisms is placed inside the telescope tube and intercepts the rays of light just before they come to a focus. And in a third one, figured in all treatises and called Secchi's star spectroscope, the whole spectroscope with its collimator, prism system and view telescope, is put outside of the eye end of the large telescope. And lastly, he was the first to "make the curious and interesting" combination (Frost p. 109) of this third form of the spectroscope with the first.

Not only did Secchi design spectroscopes, but he used them with an intelligence and an assiduity that have justly immortalized him. The sun claimed the greatest share of his attention, on account, not only of the more congenial time of its appearance but also of its abundance of light, which permits of such minute analysis of its features. Father Secchi studied the sun most thoroughly, and by applying to it his telescope, spectroscope and photographic camera, by examining in every conceivable way its photosphere, chromosphere, spots, faculae, prominences and corona, he was in a position to formulate a theory of its constitution, of the nature, formation and dissolution of its spots and prominences, and of its entire body. This theory has received the highest commendation from all the greatest astronomers during and since his time. Thus the late Simon Newcomb, acclaimed to have been the greatest mathematical astronomer of his day, devotes a considerable space in his text book of POPULAR ASTRONOMY to what he calls "Secchi's first theory" and "Secchi's later theory" of sunspots. Langley, at his death director of the observatory of the Smithsonian Institution in Washington, gives a number of Secchi's illustrations in his *New Astronomy*. And "Secchi's typical sunspot" as well as other figures and theories still appear in every popular and technical treatise on the sun, such as, to mention only one, Young's *The Sun* and Abbot's revision of the book. G. E. Hale, first director of the Yerkes Observatory, and now of that of Mount Wilson, one of the greatest living authorities on the sun, has the deepest respect for the name of Angelo Secchi, as his numerous publications abundantly show. It was no doubt at his initiative that at the Fourth Conference of the International Union for Coöperation in Solar Research, held at Mount Wilson, August 29-September 3, 1910, the resolution was adopted "that the fund raised in Italy as a memorial to Father Secchi be devoted to the construction of a tower telescope" (POPULAR ASTRONOMY XVIII, 500).

Two of Father Secchi's brothers in religion were present at this conference, Fr. A. Cortie of Stonyhurst College Observatory in England, held to be the best informed on the connection between sunspots and terrestrial magnetism, and Fr. R. Cirera, of the Ebro Observatory in Spain, whose specialty is the study of the connection between changes on the sun and changes in our weather.

Along with De la Rue, Secchi deserves the distinction of having been the first to photograph the sun's corona during a total eclipse. This happened July 18, 1860, in Spain. As nothing at all was known at the time of the character of the plate to be used, its degree of sensitiveness, the length of the exposure, and of many other details, "a shot had to be fired in the dark" as Miss Clerke expresses it in her *History of Astronomy during the Nineteenth Century* (Second edition, page 211). It had not even been proved at the time that the prominences and the corona really belonged to the sun instead of to the eclipsing moon or to our own atmosphere. The photographs taken at this eclipse established this point to a certainty, since the two observers were about 250 miles apart, and their photographs showed not only identical details, but also the moon's motion over them in the interval.

Father Secchi embodied his discoveries on the sun in a work which will always be considered a classic in astronomical literature. It was entitled *Le Soleil* and was written in French and printed in Paris in 1870. It is mentioned in every treatise on the sun that has appeared since, and its illustrations are largely drawn upon even at present. A second edition appeared five years later and was soon after translated into German, Spanish, Italian and other languages.

The second great luminary of the sky, the moon, claimed a much less proportionate share of Secchi's attention than its brilliancy would seem to warrant, although he made frequent measurements of the heights of its mountains, and often examined its surface features.

Every one of the planets was most critically scrutinized by him. He was one of the first to see the so-called canals on Mars (Clerke p. 327) to observe Jupiter's third satellite as spotted (p. 339), and the like. The spectroscope was of course rigorously applied to them. While later observers have since obtained more extended results with larger and better instruments, Secchi's name is mentioned with honor among them (Frost pp. 195-207). The comets did not escape his all-searching spectroscope, and he has left us technical papers on the spectra of Temple's, Brorsen's, Winnecke's, Coggia's and Borrelly's comets (Frost p. 451). In the same way he examined the spectra of nebulæ, meteors and auroras (ib. p. 453, 222, 462).

But it was in regard to the stars more than to any other class of heavenly bodies, with the possible exception of the sun, that Father Secchi has won for himself an undying name. Besides measuring the positions of innumeral double stars—Gledhill's *Double Stars* mentions his observations on almost every page—he was the founder of a new branch of astronomy, stellar spectroscopy, and his analysis was so comprehensive and so thorough, that "Secchi's Types of Stellar Spectra" will ever remain an essential illustration in astronomical textbooks.

Miss Clerke says (p. 421): "The effective founders of stellar spectroscopy.....were Father Secchi, the eminent Jesuit astronomer of the Collegio Romano, where he died, February 26, 1878, and Dr. Huggins, with whom the late Professor W. A. Miller was associated. The work of each was happily directed so as to supplement that of the other. With less perfect appliances, the Roman astronomer sought to render his extensive rather than precise; at Upper Tulse Hill, searching accuracy over a narrower range was aimed at and attained. To Father Secchi is due the merit of having executed the first spectroscopic survey of the heavens. Above 4000 stars were in all passed in review by him, and classified according to the varying qualities of their light. His provisional establishment (1863-67) of four types of stellar spectra has proved a genuine aid to knowledge through the facilities afforded by it for the arrangement and comparison of rapidly accumulating facts. Moreover, it is scarcely doubtful that these spectral distinctions correspond to differences in physical condition of a marked kind."

The successors of Father Secchi in stellar spectroscopy, notably Vogel of Potsdam and E. C. Pickering of the Harvard College Observatory, have somewhat modified his original classification of four orders of spectra, and, as the progress of science has justified, have divided and subdivided them very minutely. The original grand division of the spectra according to the intensity of their hydrogen lines, is, however, still observed at the present day. What amount of patient endurance the critical visual examination and classification of the spectra of 4000 stars entails, the unprofessional reader cannot possibly realize. Some faint idea of the labor may be obtained when we reflect that all this work had to be done at all hours of the night and at all seasons according as the stars came into favorable positions for observation. When the moon was bright, this work had to be practically suspended, because it dimmed the fainter stars as much as it superimposed its own spectrum upon them. Adding to this the caprices of the weather, the occasional indispositions of body or mind, other pressing duties, and a host of interruptions, such as entertaining distinguished visitors that his fame and admirers must have foisted upon him in the centre of Christendom, we see that his endurance is as much, or rather much more, to be praised than his genius.

While Father Secchi's observational work at the telescope would seem by itself to be more than sufficient for the life work of one man, his literary activity almost passes belief. He was keenly conscious of the fact that observational labor is but half the work, and that it is but a useless waste of energy unless it is discussed and sifted, arranged and published. For this reason he used his pen as much as his telescope, and made all of his observational data accessible to the scientific

world. If we would have an idea of the stupendous amount of his writings, we have but to consult the *Bibliothèque de la Companie de Jésus*, new edition, in nine volumes quarto, by Father Carlos Sommervogel, which records the literary activity of the Society of Jesus. There under the name of Angelo Secchi, we will find that the bare enumeration of the titles of his productions, without comment and without repetition, covers the amazing number of nineteen pages quarto in double columns. One hardly knows whether he can trust his eyes in scanning this long array, although the most exact references are given. He sent at least 671 communications to 42 journals. Of these, 182 appeared in *Comptes Rendus* and 132 in the *Astronomische Nachrichten*, the two foremost astronomical journals in the world. There were 81 in the publications of *Academia Pontificia de Nuovo Lincei*, 46 in the *Italian Spectroscopical Society*, 7 in the *Monthly Notices of the Royal Astronomical Society*.

Besides these articles Father Secchi wrote at least five books. His first was *L' Unità delle Forze Fisiche*, an admirable work, in which he shows the wonderful unity that obtains among the forces of nature, and how this unity is a proof of the existence and oneness of the Creator. It was published in Rome in 1864 and went through two Italian, one German and one French edition. The second book was *Le Soleil*, 1870, mentioned before, which reappeared in a second edition in 1875. The third was *Le Stelle*, Milan, 1877, in which he embodied his observations on the stars. It was translated into German and French. The fourth was a *Treatise on Cosmography* for the use of schools, and the fifth, a posthumous work on the *Elements of Terrestrial Physics*, 1879.

Although this article deals with Father Secchi mainly as an astronomer, it will be of service to mention a few of his labors in other closely related branches. Secchi was by nature a great experimenter. He studied many laws of nature at his own experience rather than on the word of others. This trait of his character manifested itself early in life. It was while he taught physics in Georgetown College in 1848-49 that he investigated the behaviour of bodies when under the influence of an electric current. As a true scientific man, he at once put his results into writing. This was the first production of his untiring pen. It is no little honor to Georgetown College and to the United States that the very first work that Father Secchi ever wrote, should have been published by the Smithsonian Institution of Washington, D. C., and should have appeared in one of the earliest volumes of that glorious series which annually contains the very best and latest articles by the leading scientific men of the time on their own specialties. Although written in 1849 and accepted the following year, it was not actually

published until 1852. The full title of the work is *Researches on Electrical Rheometry* by A. Secchi, Professor of Astronomy and Director of the Observatory in the Roman College (Rome), and late Professor of Physics and Astronomy in Georgetown College (D. C.). Accepted for publication by the Smithsonian Institution, September 1850. Vol. III Art. 2 of Smithsonian Contributions. Washington, 1852. 4°."

Experimenting with electric currents very naturally led the way to the study of magnetism, not only electro-magnetism but also that which is termed permanent and telluric. It is in this latter kind that the pioneering genius of Father Secchi again showed itself, inasmuch as he was one of the first to build a magnetic observatory and to investigate and record the three elements of terrestrial magnetism: the declination, or as it is more popularly called, the variation of the magnetic needle, that is, the angle it makes with the true or astronomical meridian; its inclination or dip, that is, the angular depression of one end of the needle below the horizontal plane; and lastly, the local intensity or strength of the earth's magnetism. While the determination of these three elements is of sufficient importance in itself especially that of the declination in navigation, it is essentially the variation of these elements that calls for the expense and use of a magnetic observatory. This variation is of two kinds, periodic and accidental. The first is subdivided into diurnal, annual and secular. The second may occur at any moment and be of any magnitude. The magnetic needle is often violently disturbed when there is an eruption of unusual violence on the sun or when spots are in certain positions. It is known for certain that the frequency of magnetic storms on earth follows the eleven-year cycle of sunspots, and that therefore there must be a causal connection between the two. The relation of terrestrial magnetism to astronomy is thus seen to be already intimate. It may be even more than we can at present surmise. Father Secchi has thus another claim upon our esteem in that he built a magnetic observatory in connection with his astronomical one. His brethren in religion have caught up his spirit, for they now have at least four modern and fully equipped magnetic observatories, at Stonyhurst in England, at Manila in the Philippine Islands, at the Ebro Observatory in Spain and at Zi-ka-wei in China. Those at Havana in Cuba and at Tananarivo in Madagascar are less fully furnished, but doing good work.

Father Secchi also built a third observatory, which to the public mind may seem to be of greater practical utility than the other two. This was a meteorological one, in which all the elements of the weather were observed. True to his character, Secchi at once communicated his observations to the scientific world by issuing a regular annual

publication called the Meteorological Bulletin. It contained between 96 and 192 pages, and appeared for seventeen consecutive years up to the time of his death. In this also his Jesuit brethren have followed him. Besides the great meteorological observatories in Manila and Zi-ka-wei, which are of inestimable value to the Far East, regular observational work is conducted and publications issued also by Tananarivo, Stonyhurst, Kalocsa in Hungary, Granada and at the Ebro in Spain, Havana and Cienfuegos in Cuba and other places.

As the frequent reading of the many instruments called for a considerable amount of time, and entailed the additional disadvantage that sudden changes between the readings went unobserved, Father Secchi with a true Yankee ingenuity which we Americans would hardly expect to find in an Italian, set to work to make all his instruments automatic and self-recording. He displayed a wonderful resourcefulness in many of his contrivances. His barometer, for example, was a novelty in this that while he employed a tube filled with mercury, he made this tube of metal instead of glass, expanded the diameter of its upper part, suspended it from one arm of a balance and recorded its oscillations by a pen attached to the other arm in such an elegant scientific way that no temperature correction was necessary, since his barometer really measured the weight or pressure of the air directly, and not indirectly as ordinary barometers do in the height of a column of mercury. His dry bulb and wet bulb thermometers had inlet wires at the bottom, while other wires were lowered into them from the top at regular intervals by a chord and pulley. As the dry bulb thermometer always indicates a higher temperature than the wet bulb, the mercury in its tube was the first to be met by the descending wires. An electric circuit thus closed operated a pen and made a mark on a sheet of paper. As soon as the second wire touched the mercury in the wet bulb thermometer, a second circuit was closed. This broke the first circuit, and raised the pen. In this way the beginning and end of the line on the paper indicated the temperatures of the two thermometers, and its length showed the relative humidity of the air.

Secchi's meteorograph at once met with a well merited applause. It was exhibited at the Paris Universal Exposition of 1867 where it won for its inventor the Grand Prize of one hundred thousand francs and the Cross of the Legion of Honor. This distinction was conferred upon Father Secchi by the Emperor Napoleon III in person, in presence of the Emperors of Russia and Austria and of the Kings of Prussia and Belgium. The Emperor of Brazil sent him a golden rose as a token of his appreciation. The original meteorograph exhibited at this Exposition is at present set up at Zi-ka-wei, and there is a second in St. Ignatius College, Cleveland, Ohio. Illustration and detailed descriptions of it are given in every edition of *Ganot's Physics.*

It is no wonder then that the scientific world in learning of his achievements soon placed its laurels upon Father Secchi's brow, and esteemed it an honor to count him as a member of its societies and organizations. Thus he was a member of the Philosophical College of the Roman University, of the Academia de Nuovo Lincei, of the Forty della Società Italiana, of the Institut De France (better known as the French Academy), the Royal Astronomical Society of London, of the Academy of Science of Turin, of the Institutes of Lombardy, Venice, and others too numerous to mention.

If the scientific world showed such appreciation of his worth, we may imagine with what affection and esteem he was regarded by the Pontiff Pius IX, who could justly look upon him as the ablest of his scientific sons. Nor did the pope confine his admiration to mere verbal expressions. He supported it in a most substantial way by large pecuniary donations, without which modern science can scarcely make much progress.

The absence of the least stain upon his character, and the universal esteem with which he was regarded by the whole world, are sufficient proofs that Father Secchi's life as a man, a Catholic and a Jesuit, was above reproach and worthy of the highest praise. This judgment is confirmed by his conduct at the taking of Rome by the Italian government in 1870, one of whose very first acts was to drive the Jesuits into banishment and to confiscate their property. The Roman College was turned into barracks for the soldiers. But the universal protest of the scientific world compelled the new rulers to safeguard the famous observatory and to reinstate its renowned director. But Father Secchi scouted the idea of being in the employ of a government that had so high-handedly expelled his brethren, that had robbed the Church of the last remnant of its temporal dominion and had imprisoned the Father of Christendom. True to his principles he willingly sacrificed what he prized most highly of all earthly goods. It was only an act of obedience, the characteristic virtue of a Jesuit, that brought him back to his observatory, for it was only at the wish of Pius IX himself, now become a prisoner, that Father Secchi, consented to return. The Italian government then personally exempted him and Respighi, the illustrious spectroscopist, from the oath of allegiance to itself. For seven years more Father Secchi then occupied the post he had already made so famous, and finally died after an illness of three months on February 26, 1878, at the age of 59 years and 8 months, after having been director of the Roman College Observatory for less than 29 years.

This noble incident in Father Secchi's life may be paralleled by the conduct of Galileo before the Roman Inquisition. We are all convinced that Galileo had great nobility of character, that he would never

descend to any duplicity nor act except from conviction. Now we all know that he submitted to the sentence passed upon him and that he never again for the rest of his life taught the forbidden doctrine. Hard as we love to imagine it must have been for him to abandon his Copernican ideas, he made the sacrifice nobly. He must have been convinced that his judges did not exceed their authority, and that membership in the Church of Rome was more to be prized than his new astronomical theories. His submission then ennobled him more than all his scientific discoveries. His judges could not therefore have been so unjust as they are now generally pictured to have been, nor could the Church of Rome have been as hostile to science as is so frequently stated. For with the sole exception of not teaching the Coperican system, Galileo had all the liberty and as much of encouragement as Father Secchi ever enjoyed, so much so in fact that it was only after the much misrepresented condemnation that he wrote the best work of his life, the one on mechanics, in which he displays more thorough scientific genius than in all of his astronomical discoveries. Taken even at its worst, the Galileo incident is the only one to its discredit in the history of the Catholic Church in the course of nearly two thousand years. Why then should she always have this mistake held up to the gaze of the world? Has she not more than atoned for it by her treatment of Father Angelo Secchi? Has not Pope Pius X given proof of his appreciation of astronomy by equipping the Vatican Observatory? His successor, Benedict XV, is maintaining it even in these troublous times. Has not its renowned director, Father Hagen, the author of the *Atlas of Variable Stars*, written an exhaustive work on *Experimental Proofs on the Earth's Rotation* (reviewed in these pages XXI 208) and adorned it by two original determinations made in the Vatican Observatory itself? In view of the encouragement and substantial coöperation afforded Fathers Secchi and Hagen by the late Pontiffs, the much misrepresented case of Galileo ought in all fairness be dropped from astronomical journals.

A SUGGESTED EXPLANATION OF THE PHENOMENA PRESENTED BY A NOVA.

WILLIAM H. PICKERING

An explanation formerly given was that the appearance was due to the collision of two stars. There are two objections to this suggestion. In the first place novas are a rather frequent phenomenon, those bright enough at maximum to be visible to the naked eye occurring every three or four years. The stars are altogether too small in proportion to the distances between them to permit of such frequent collisions. In the second place a nova cools down too quickly. The mass of any two stars such as those with which we are acquainted, if they came in direct collision, would require centuries instead of weeks in which to cool.

In an effort to avoid the first of these difficulties it was suggested that the stars need not necessarily collide, but merely pass near enough to produce violent tides, tearing open the surface and exposing the hot interior. The light of the recent nova in Aquila increased 100,000 times in six days. It is clear that no tidal effect could produce such a result. Nevertheless it is certain that at least one massive brilliant remote star is associated with the phenomenon, because in the present instance as in several others, the star has been observed or photographed prior to the collision.

Another suggested explanation was that the phenomenon was due to an encounter of a star with a meteor shower, in other words a comet The obvious objection to this is that the masses of all known comets are infinitesimal, and would be wholly inadequate to produce the effects observed.

The last and at present most popular explanation is that the outburst is due to the collision of a star and a nebula. This entirely avoids the first difficulty, if the nebula is big enough, but not the second. The recent nova was certainly not more than six days in reaching its maximum brilliancy, immediately after which it rapidly decreased in light. If the star was traveling through the nebula at the rate of speed of the earth in its orbit, which is a fair rate for an average star, in six days it would have traveled 9,000,000 miles. If spherical this would be a very small nebula indeed, and an object that it would be very unlikely that a star would hit. This difficulty might be avoided if we assume

the nebula to be spread out into a wide flat sheet, having only that thickness. Novas never last very long, so that this theory would imply that most nebulae are flat and thin, and are always crossed transversely, both of which propositions seem improbable.

But there are still more serious objections to this theory. It was originally suggested to explain the usual nova spectrum, that of bright lines accompanied on their blue side by heavy dark ones. The bright lines were supposed to be due to the nebula, and the dark ones to the star. The spectra of a very considerable number of novas are now known, and in all cases the dark band is on the blue side. Therefore in every one of these cases the nebula must be receding and the star approaching. Moreover the velocities are extraordinarily high, several hundred miles a second, so that the direction of the collision must be always nearly in the line of sight. These facts seem improbable.

Still another difficulty is that the nova in at least two other cases besides this one had reached its maximum brilliancy before the bright lines appeared,—in other words before the star reached the nebula.

The recent nova was first noticed at the Harvard Station in Jamaica on June 9, a few hours before its maximum brilliancy was reached. Its color was then recorded as being 0.3 way from that of Vega towards Arcturus. On June 10 its color was described as Vega 0.1 towards Arcturus. On the Color Scale and using the color wedge (POPULAR ASTRONOMY 1917, **25**, 75, 1918, **26**, 313) Arcturus measured 11.5, the nova 9.0, and Vega 8.0. The scale divisions however are not quite equal. Its real color therefore, if the eye were not dazzled by its brilliancy, as shown by the scale would be described as bluish white. This was the bluest hue that it ever reached with a continuous spectrum. A second estimate of the color gave Vega 0.15 Arcturus. On June 11 the color had begun to turn distinctly yellowish, and was now found to be recorded Vega 0.5 Arcturus. On June 12 through clouds, its color seemed to be that of Arcturus, type K. On June 13 through very thin haze this observation was corroborated. On June 14 its color was recorded as that of α Ophiuchi, type A5. On June 24 the nova was of the same brightness as γ Aquilae, type K2, but redder.

On June 28 on the Color Scale Arcturus measured 11.2, and the nova 15.3, or 4.1 divisions redder than Arcturus. It was therefore the reddest star in the heavens visible to the naked eye. For comparison we may state that for 19 Piscium, type N, and for the variable μ Cephei, Ma, the two reddest stars that we had previously measured, the difference is only 3.0 divisions. When the eye was protected from being dazzled by throwing the image out of focus, the appearance of the nova was that of a brilliant red, but more crimson than the corresponding divisions of the Color Scale.

The following naked eye estimates of brightness were made in June, $9^d\ 16^h\ 30^m$ G. M. T. As compared with Arcturus its magnitude was -0.26. At $16^h\ 50^m$, as compared with my recollections of Sirius and Canopus, it was -1.22. The brightening was probably due to the clearing away of unnoticed cirrus cloud. 19^h still brighter. As compared with my recollections of Sirius it was now -1.40.

June $10^d\ 15^h\ 05^m$ magnitude $+0.22$. $15^h\ 20^m$ $+0.14$. $16^h\ 12^m$ $+0.04$.
11 13 30 $+0.64$. 15 50 $+0.04$. 15 55 -0.16.
12 Mean of five observations through thin clouds $+0.64$.
13 16 05 1.19
14 15 00 1.19, $15^h\ 30^m$ 1.46, 1.33 (better).
16 16 30 1.95 1.84.
24 14 10 2.80, 3.02.
25 13 00 3.02.
27 13 05 3.78
28 14 50 4.06

The following estimates were made in July.

July	5^d	13^h	15^m	3.02	July	11^d 16^h 20^m	4.06
	6	15	50	3.55		12 15 05	4.10
	7	13	45	3.42		16 14 05	3.69
	8	13	10	3.55		17 13 35	3.69
	9	15	50	3.68		18 13 00	3.82
	10	14	45	4.05			

By August 1 the redness had clearly diminished, and the color was only 12 on the Color Scale. On August 7 Arcturus measured 10.5, so that the excess of red on August 1 was only 1.5 divisions of the scale. On August 7 the nova equalled No. 7 of the scale, and it was therefore 3.5 divisions more blue than Arcturus! It was in fact bluer than at the early color maximum on June 10. The spectrum was now however, quite different from that shown on that date, and the blueness depended merely on what lines were prominent in its spectrum. An examination of the image in different foci of the telescope, seemed to indicate that the red lines were less prominent, and the yellow ones much more so than before. An examination through the opera glass showed that in brightness the nova equalled θ Serpentis, magnitude 4.1, type A5, and was somewhat more blue. It had also brightened 0.7 magnitude since August 5. On August 8 it was again recorded as equal to θ Serpentis, and not very different in color, perhaps redder. It was clearly redder than λ Aquilae, magnitude 3.55, type A.

In framing the various hypotheses hitherto considered, the plan of their different authors has evidently been to try all the types of known heavenly bodies, and see which one if brought into collision with a star would most completely reproduce the observed phenomena. Since none of the results seem to be entirely satisfactory, let us adopt another

plan. Starting with the observed facts, let us see what kind of a body colliding with a star would be most likely to produce them. The most important question obviously relates to its mass. The facts observed in the case of the recent nova, which typifies many others, are that on June 3 it was of its former usual brightness, namely the eleventh magnitude. Four days later its brightness had increased one hundred times. The next day it had increased one hundred and sixty times, and the following day six times more. It was then at its maximum brilliancy, and was 100,000 times as bright as it had been six days previously. The increase may have been still more rapid than this, since we have no means of knowing how bright it was upon June 4, 5, or 6 (Harvard Bulletin 658). It may therefore have reached its maximum brilliancy in three days. Since June 9 it has with some fluctuations steadily decreased in brightness.

In order to fix our ideas, and obtain a general impression of the sort of body that would be required to produce the results observed, let us imagine an object, which we will call a planetoid, whose mass is one one-hundredth part of that of the Earth, and let us imagine it precipitated upon the sun from a very great distance. Its velocity on striking the solar surface would be nearly 400 miles per second, and if the heat produced were uniformly distributed in time, it would furnish an output equal to that of the sun at present for about 300 days. But suppose that the output was not uniform, and that at the maximum the heat was given out so fast that at a uniform rate it would last only six days. The heat emission would then be 50 times as great as at the present time.

If we knew the parallax of the nova, or the type of its spectrum prior to the collision, these facts would be of great assistance in the present investigation. The latter we can now never determine, unless some early visual observation of it is discovered, or unless photographs of it in the past years were secured on ortho-chromatic plates. Its enormous increase of brightness, combined with the fact that at its maximum its spectrum was only as blue as type A, leads us to believe that it was originally a rather non-luminous red or yellow star,—in short a dwarf. The great majority of yellow stars are of type K. In Eddington's "Stellar Movements" are given two tables (on pages 41 and 47), relating to the luminosity of the nearest stars,—those whose parallax is best determined. Eight of these pertain to type Ma, and we find that their mean luminosity is 0.025 ± 0.018, that of the sun being taken as unity. Twelve pertain to type K, and their mean luminosity is 0.53 ± 0.40.

The surface temperatures corresponding to some of the different types as given by Russell in Popular Astronomy 1914, **22**, 278, are type

A 11000°, G 5000°, K 4200°, M 3100°. If a planetoid were to strike the sun, converting it temporarily into a star of type A, its surface temperature would be increased 2.2 times. Raising 2.2 to the fourth power, by Stefan's law, indicates that the sun would then be giving out 23 times its normal output of heat. According to Russell (POPULAR ASTRONOMY 1914, **22**, 338), it would be shining with nine times its normal light. If the nova were originally of type K, and but 0.53 times as bright as the sun, its increase of brilliancy would be only 17 times.

Intrinsically it could not possibly be brighter than this, for, as we have stated, its color was never as blue as that of Vega, type A. But we have already seen that its total light increased 100,000 times. The only possible explanation of this difference would then seem to be that its surface increased 6000 times. If its spectrum prior to the collision had been that of type Ma, its intrinsic brilliancy would have increased 360 times, so that its surface need have increased only 280 fold. It can hardly have been as red as this type however, or it would have been previously recorded visually. We shall assume therefore in this discussion that prior to the collision its spectrum was of type K.

We all know that when a shell fired from a cannon strikes the sea at a small angle, it sends up an enormous vertical splash. In the case of a nova besides the ordinary splash, there would be a tremendous explosion, on account of the heat generated converting the solid material of the planetoid into gas, and expanding the gases in the interior of the star. We may perhaps imagine that if a projectile of the size and mass of the suggested planetoid, or of our moon, were to strike the sun with a velocity of 400 miles per second, it would penetrate the photosphere, and explode somewhere in the interior, scattering the photosphere in all directions. If the enlarged photosphere presented 6000 times the original surface of the sun, its radius would be 33,000,000 miles. To increase to this size, assuming that the material was projected from the sun's surface with a parabolic velocity, would require 1.6 days. The increase of brilliancy certainly required longer than that in the case of the recent nova, involving therefore a velocity of projection somewhat less than that with which the planetoid is assumed to have fallen.

It appears therefore that the enormous light given out by the nova at the time of maximum was not due to the collision itself, but rather to the explosion caused by the collision. The light was really developed from the stored energy of the star. Professor Russell has pointed out that in one day, at the maximum, the star gave out more light than in the preceding 250 years, assuming its light during that time to have been fairly constant and of the eleventh magnitude. This statement is certainly striking, but let us assume that the total excess of light, due

to the explosion is one hundred times greater still. This would cause a loss of stored energy equal to that radiated during 25,000 years,—a period wholly negligible in the life of a star, which is reckoned in hundreds of millions. Indeed it would be only a very small fraction of one per cent.

If we imagine that in the case of very hot stars the photosphere is thin, becoming denser and heavier in those of cooler types, then it would appear that the explosive energy developed in the latter would be more violent than in the former, especially if portions of this surface were in a semi-liquid condition. It further appears therefore that we have so far no clue whatever regarding the necessary mass of the planetoid.

While it is impossible for us to picture to ourselves phenomena occurring upon such a vast scale, yet by reducing the size of the objects in our imagination, we may be able to judge more clearly whether the facts postulated would be likely to produce the results observed. Instead of our moon striking the sun, let us picture a 3-inch meteorite penetrating a sphere 100 feet in diameter, with a velocity of 400 miles per second. The amount of heat generated we know would be enormous, but this too it is difficult for us to picture to ourselves. Let us therefore reduce the velocity 1000 times, and bulk of the sphere 1000^2, giving it a diameter of 12 inches. A 3-inch round shot moving with a velocity of 2000 feet per second would then deliver the same amount of energy per unit mass of the 12-inch globe, that the meteorite did to the 100 foot sphere. In the case of the meteorite the mechanical effect is converted first into heat, and then back into mechanical effect. In the case of the slow moving cannon ball, the slight rise of temperature due to the collision would produce but little effect on the kinds of matter with which we are familiar, and the destructive effect of the energy transported would be delivered without conversion direct to the globe. The effect would obviously be considerable. Indeed we may fairly say that a much smaller projectile moving with that velocity would damage a 12-inch globe as much as the assumed planetoid seems to have damaged the nova, judging by the computed loss of radiant energy. Let us then place 2000 miles as a maximum diameter of the planetoid, and 500 miles as a large but more probable value. Such a body would have one four-thousandth the mass of the Earth.

It will be noticed by the observations that the brightness on June 10 was 1.5 magnitudes fainter than on the previous day, that is to say that in twenty hours the nova had lost three-quarters of its light. As we have already seen it also became bluer. This would imply that the photospheric masses fell back towards the star, thus becoming hotter. Various other circumstances may also have influenced the result. The

spectrum indicates that the eruptive prominences of hydrogen and helium first burst through the photosphere on that date.

The usual spectrum of a nova after the explosion has taken place consists, as is well known, of bright and dark lines, the bright ones being displaced towards the red end of the spectrum. These indicate that the flames of hydrogen and other gases are receding from the earth, while the dark lines indicate similar flames approaching us. The word explosion is used advisedly. The velocities observed far exceed those produced by any terrestrial explosion, but the outrush of gas continues uninterruptedly for days or even weeks at a time. The reason why the approaching flames appear dark and the receding ones bright is readily understood if we assume that both are hottest, and therefore brightest, where they issue from the star. As they recede from it they cool, and those approaching us are preceded consequently by a cool comparatively dark cloud of gas, giving rise to dark lines. Those receding from us on the other hand have the dark cloud on the further side of them, and therefore appear bright. The dark cloud approaching us cannot absorb the light of the bright rays from the receding flames because they are of a different wave length (Astronomy and Astro-Physics 1894, 201). The fact that vast quantities of gas are really emitted is clearly indicated by the observation that in several cases the later spectrum of the nova has become that of a nebula. These cool gas clouds gradually conceal the nova, which only reappears when they have condensed upon it, or dissipated.

Having now stated our explanation of the phenomena observed, let us look at it from a slightly different standpoint. We have suggested that a planetoid might produce the observed phenomena. Now assuming that such a planetoid really exists, we ask could it in fact do anything else, or act in any way differently? If a sphere such as we have supposed were to strike the sun with a velocity of 400 miles per second, it would be in part vaporized before reaching the surface, and it would then certainly penetrate the photosphere and explode, its whole substance being suddenly converted into gas. We cannot well conceive of any other result. The photosphere would certainly be projected upwards, although we cannot say how far, and following it the gases generated and those of the sun's interior would escape. The violent phenomena would only last for a few weeks, but while they lasted it is very certain that many of the phenomena exhibited by a nova would be produced.

The next question that we should naturally ask is, is there any other evidence besides that of novas that such planetoids really exist? There is certainly no direct visual evidence, for even if such a body were now actually approaching us, and were already well within the orbit of

Saturn, and about to reach us within two or three years, it is very doubtful if we should be aware of its presence. For 100,000,000 years no such body has collided with the sun, but several may have passed near it within that time. It is possible that the two intensely bright objects which suddenly appeared to Carrington in 1859 while he was watching a sunspot may have been small bodies of this character. The observation was independently confirmed by Hodgson, who describes the appearance as a "very brilliant star of light, much brighter than the sun's surface and most dazzling to the protected eye." The whole phenomenon lasted only five minutes, and the two objects moved over their doubtless much foreshortened paths at the rate of 120 miles per second. Since the sunspot was unaffected in any way by the phenomenon, the latter doubtless occurred at a considerable elevation above the solar surface, and its superposition upon the spot was merely accidental. Violent electro-magnetic disturbances were immediately produced upon the Earth (M. N. **20**, 13).

It is not necessary however to suppose that the planetoids are uniformly distributed throughout space, or that they are all of equal size and mass. Indeed, judging by the distribution of the observed novas and the Wolfe-Rayet stars, which are associated with them, we may conclude that they are confined largely to regions very remote from us in the vicinity of the Galactic Equator. It is only from the frequency of novas that we can judge how numerous such planetoids may be. It is quite possible too that they may frequently travel in clusters like stars, or like meteors. A cluster composed of a few thousand such bodies, even if they were separated by many millions of miles, would be a very dangerous object for a star to encounter, and yet at the same time would be of insignificant mass and brightness.

A concentrated cluster of a thousand million such bodies, if heated by mutual collisions, might appear to us a good deal like a giant star of type M or N. It will be recalled that some of the former and many of the latter are now recognized as irregular variables. These stars are all of extremely low density, some according to Russell being of less than one twenty-thousandth that of the sun, or about one twentieth the density of our atmosphere at sea-level. It is difficult for us to picture to ourselves an enormous mass of gas of such comparatively low temperature and density, and yet with so high a constant of gravity as it should possess if of such great mass. If however we consider these stars to be merely enormous groups of planetoids, like a comet or meteor swarm, but on a very large scale, much of our difficulty disappears.

If we now return to the solar system, we may find an example that is a little nearer home. Since our sun requires 15,000 years to travel

a distance of one light year, if we assume the age of the earth at 100,000,000 years, and a constant speed and direction for the sun, then at that early date our system must have been 7,000 light years nearer to the outskirts of our stellar universe, and well out towards the region where planetoids are frequent. We may then have picked up a number of them, or indeed even had a collision at that time. The ring of minor planets preserved to our day by the planet Jupiter may be a reminder of that remote event. Only one of them, Ceres, is as much as 500 miles in diameter, and has therefore the mass that we have assumed to be necessary to have caused the explosion in Nova Aquilae. However this need not surprise us, for it is possible that the terrestrial planets themselves are all only larger specimens of the same group, Moreover Nova Aquilae was not only an unusually bright star, but the velocity of its exploding gases, reaching to 1750 kilometers per second according to Harper (Journ. R. A. S. of Canada, 1918, **12**, 270), was extraordinarily high, indicating a release under tremendous pressure. This would imply either a very massive star, an unusually massive planetoid, or both.

August 15, 1918.

RECENT DOUBLE STAR WORK AT LA PLATA.

ERIC DOOLITTLE.

There has just arrived from the observatory at the National University at La Plata a most interesting volume, of 144 quarto pages, which contains the measures on double stars made during the past five years by Mr. Bernhard H. Dawson.* The measures form a beautiful series and the entire work has been very thoroughly done. It is indeed a pleasure to see appearing among the newer double-star astronomers so industrious and excellent an observer as Mr. Dawson very evidently is, and it is perhaps especially fortunate that his observatory is so far south of the equator, for among the far southern pairs, careful systematic work of this kind is especially needed.

The reader who turns the pages of the volume will see at once that it is not filled with measures of the older, well-known pairs or of binary pairs of which there is no fear that numerous other measures will be

* *Results of the Observations with the Equatorial.* Astronomical Observatory. National University of La Plata, Vol. IV, Part I. La Plata, 1918.

lacking. Nor have a large number of close pairs been measured, though Mr. Dawson states that distances nearly as small as 0″.2 have been observed, and the inclusion of a considerable number of Hussey discoveries, of which the pairs are often very difficult because the magnitudes are very unequal, show that the objective of 11-inches aperture must be a nearly perfect glass for this kind of work. It may be added that they also bear equal evidence of the excellence and skill of the observer.

Mr. Dawson did not, at least at first, have access to the telescope on the nights of best definition; these were reserved for Professor Hussey's important and well-known survey of the southern heavens for new pairs, and accordingly he made up his lists from wider and almost totally neglected pairs. The plan ultimately adopted was to include all of the 2107 pairs noted by Sir John Herschel at the Cape of Good Hope, to identify and measure each of these, and to add as many miscellaneous pairs of somewhat the same character in the same regions of the sky as might be possible. The work was started at a southern declination of 42°, and about half of the area selected for examination has now been covered. It is intended to complete in this way all of the area from the south pole to a declination of −30°, and possibly to a declination of −22°, so that the identity and description of every pair now catalogued within these limits will become known.

This is a most useful piece of work. It would be an excellent thing if some observers, even with comparatively small telescopes, would make a similar survey of the northern sky. Doubtless a single observer would not be able to include the whole heavens, as Mr. Dawson is doing, but if he selected a single zone, 10° or even 5° in width, thoroughly and systematically observing every wide pair within that zone, the result would be of definite value. As Mr. Dawson says, "This will doubtless seem an uninteresting and perhaps even useless program to those so favorably situated as to have a large proportion of nights with good definition", but such a program is far from being an uninteresting or useless one. Van Biesbroeck has measured and identified in this way all of the *H* stars lying between a north declination of 50° and the Pole, but an examination of Burnham's *General Catalogue* will show that there are many hundred of *H* pairs which are still unidentified, and many more which have never been measured since the time of *H*'s first description. Unfortunately, also, there are many discoveries of modern observers of which the rough places, only, are known, and all such pairs should be identified in the *DM* or in some other catalogue and the position of each measured from some nearby known star. This would be a work of far more value than the mere multiplication of measures on the well-known pairs of Struve and others, which are

fixed, or nearly so, and on which we at present have plenty of measures, many of which have been made with instruments of large aperture.

The present volume contains measures on 1305 pairs, 985 of which are from the Cape list of *H.* The greater number of these have each been measured on three or more nights, though with the quite wide pairs two consistent measures have usually been considered sufficient. Each night's measure is the mean of at least four settings for angle and three for double distance; a single wire is used in making the former, and the line joining the eyes is kept either parallel or perpendicular to the line joining the stars.

No attempt is made to determine the systematic errors of measurement, and this would, indeed, have been practically impossible with pairs of so varied a character and on which there have been made so few prior measures. The probable errors of observation were found, however, by comparing the individual measures of some fifty pairs with their corresponding means, and also by comparing the means of a few of the stars with the positions based on the measures of other observers. The results from the two methods are consistent, and though the probable errors are slightly larger than those found by Aitken with the 12-inch, (*Publications of the Lick Observatory*, Vol. XII, Page vii), it should be noted that the observations of Dawson were usually made on nights when the definition was not of the best. In spite of this, the probable errors at different distances compare favorably with those of other observers and are well below the average of those who employ telescopes of about the same aperture, as determined by Doberck and published in numerous recent papers in the *A. N.* As in practically all double-star observations, the measures of angle are somewhat more accurate than those of distance, although with Dawson the difference is very slight. The entire results of his investigation are given in the following small Table, the last line stating the probable error determined by the second method described above.

Mean Magnitudes		Mean Distance	p. e. in Angle	p. e. in Distance
		″	°	″
8.1	8.5	2.7	1.06	0.06
7.2	10.4	4.6	0.99	0.08
8.8	9.1	20.3	0.19	0.08
7.3	11.3	27.9	0.27	0.11
3.3	5.2	3.9	0.89	0.10

By far the greater number of pairs measured by Dawson are far below the limit, ($-31°$), of Burnham's *General Catalogue*, but there are measures of 82 pairs which are north of this limit. Dawson states that it is his intention, after his survey is completed, to publish a comprehensive Index List of all stars south of $-30°$, and this will be a

most valuable work. He plans to state the position of each of these pairs for the epoch 1950.0, a most wise choice, as it seems to us, for we are already nearer this epoch now than the standard epoch 1880.0, which has hitherto been used for double-star positions. At the Flower Observatory we have already begun the reduction of all pairs north of Burnham's southern limit to this epoch, and when the extension of Burnham's *General Catalogue* is published, this will be the epoch chosen. This decision was made after much consideration and some correspondence with other astronomers. It seems certain that in a work of this kind but little would be gained in changing from the epoch 1880.0 to some near epoch, as 1900.0, 1920.0, or 1925.0, which could serve but a temporary purpose, but that the later epoch can well be retained for nearly a century to come.

The pairs north of $-31°$ measured by Dawson have been copied into the extension of the *General Catalogue* and no errors and no misprints were found. Among these pairs, the close Hussey 1274 deserves special notice, since from the original measures of Aitken and Hussey there is obtained an angle 44° larger and a distance nearly twice as great as that stated by Dawson. This pair may therefore be a binary in rapid motion. It should also be noted that measures of two pairs of the *General Catalogue* are included in the body of the work: β 746, *2252*, will be found on page 29, and β 767, *10970*, on page 100. Both of these are below the limits of the *G. C.* though they are included in it.

The source of a curious error in a pair said to be β 751, θ *Gruis*, (Page 105), was found after some difficulty. This pair is not given in the *G. C.*, but the number is assigned to a quite different pair in $5^h\ 1^m\ 16^s, +42°\ 31'$. The southern pair was first seen by Jacob in 1845, and many later measures have been made upon it. The erroneous designation was doubtless copied from Innes' *Reference Catalogue of Double Stars*, where the same error occurs. Burnham's measure of the present pair is the 751 measure made by him on a long list of miscellaneous pairs published in the *Memoirs* of the *R. A. S.*, Vol. XLVII, Pages 167 to 326. In copying from this list, Innes made the error of assigning the number 751 to the star instead of to the measure.

Altogether the new volume of measures is a most excellent one and bears throughout the stamp of thoroughness and care. All students of double-star astronomy will welcome this new observer to their ranks and hope for him that he may long continue this needed and valuable work, of which this, his first contribution, has given such high promise.

The University of Pennsylvania.

July 16, 1918.

A GRAPHICAL SOLUTION FOR COMMON ASTRONOMICAL PROBLEMS.

JERRY H. SERVICE.*

This method gives an approximate solution of the problems involved in: 1) location of stars and planets; 2) identification of stars and planets; 3) time determination from the altitude of the sun or a star or planet; 4) finding the time of rising or setting of the sun or of a star or planet; 5) finding the time of beginning of dawn or end of twilight.

Almost every wide-awake person, whether a student of Astronomy or not, is sufficiently interested in the planets and stars to wish to know where to look for any of the more important ones at any date and time of night, or seeing a bright object in the sky to wish to know what star or planet it is. If one has ready access to a celestial globe or to one of the small equatorial telescopes now on the market, such knowledge is readily obtainable. Unfortunately, however, such apparatus is not commonly available, and the method here described was devised by the writer for the use of those whose equipment is limited to star map, pocket magnetic compass, drawing compasses, rule, pencil, paper and timepiece. The processes are essentially the same as one would use on a celestial globe, but are modified to enable one to carry them out on a flat piece of paper.

We may imagine the heavenly bodies as located on the inner surface of an enormous sphere with the observer at the center. If we should extend the plane of the earth's equator outward from the earth's surface, it would intersect this great imaginary sphere in a great circle. This circle is known as the celestial equator. If now we extend the earth's axis it will pierce our great imaginary sphere in two points that are known as the north and south celestial poles and correspond to the north and south poles of the earth. Running from pole to pole at right angles to the celestial equator and through the vernal equinox, is a half circle, the vernal equinoctial colure.

Now just as the position of a place on the earth's surface is defined by its distance in degrees north or south of the earth's equator and its distance in degrees east or west of the Prime Meridian of Greenwich, so

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is the position of a heavenly body on the great imaginary "celestial sphere" defined by the distance of the body north or south of the celestial equator and its distance east of the vernal equinoctial colure. The first of these distances, which corresponds to latitude on the earth's surface, is the star's *declination*, and is measured in degrees from the celestial equator, + to the north and − to the south. The second of these distances, which corresponds to longitude on the earth's surface, is the star's *right ascension*, and is measured in hours (24 hours being equivalent to 360°) from the vernal equinoctial colure toward the east.

From the star map or from star table one can find the right ascension and declination of a star. To know where to look for it in the sky at a given time one must have some means of finding: 1) the direction of the star, i.e., whether it is east, west, north or south, etc., and 2) the height of the star above the horizon. The direction is given by the star's *azimuth*, which is the number of degrees from the point due south of the observer around toward the west to a point directly beneath the star. The height of a star above the horizon is expressed in degrees (it is 90° from the horizon to the point overhead) and is the star's *altitude*. To make clear the meanings of these two terms we may state for example that a star having at a given time an azimuth of 90° and an altitude of 30° would be at that time due west and one-third of the way from the horizon to the point directly overhead; while a star having at a given time an azimuth of 225° and an altitude of 45° would be at that time northeast and half way from the horizon to the point overhead. To locate a star in the sky we must solve the problem: *given*, the star's right ascension and declination, the observer's latitude and the date and hour; *to find*, the star's azimuth and altitude.

If we see a bright star at a given time we can estimate its azimuth and altitude. If then we can work out its right ascension and declination we can locate it on the star map or in the tables and find out what star or planet it is. In other words, we can identify a bright star or planet at a given time by solving the problem: *given*, the star's azimuth and altitude, the observer's latitude and the date and hour; *to find*, the star's right ascension and declination.

In either locating or identifying a star it is also a great help to note on star map or table or sky the brightness, or magnitude, of the star as compared with that of some star with which the observer is familiar.

I. *To locate in the sky a given star or planet at a given place at a given date and hour.*

1. Add the number of hours since noon, sun time, to two hours times the whole number of months since the last March 22, and to the result add four minutes times the number of days since the last 22nd of a month. This sum will be approximately the right ascension of

stars on the meridian of the place at the given date and hour. The meridian of the place is the imaginary circle in the sky, or celestial sphere, that runs due north and south through the point directly overhead and the point directly beneath the observer. From the right ascension of stars on the meridian, thus obtained, subtract the star's right ascension. The result will be the star's *hour angle*, which is the number of hours since the star crossed the meridian. If necessary to make the subtraction possible, add 24 hours to the right ascension of stars on the meridian before subtracting. If the hour angle comes out greater than 24 hours, subtract 24 hours from it. If the hour angle thus obtained lies between 0 and 12 hours, the star is in the western sky; if the hour angle lies between 12 hours and 24 hours, the star is in the eastern sky.

Example. Latitude is 42° N. Find Regulus, right ascension 10^h 4^m, declination + 12°, at 10:30 P. M., local time, on January 16.

January 16 is 9 months 25 days after March 22.

$9\times2^h + 25\times4^m = 18^h + 100^m =$ R. A. of sun =	19^h	40^m
Hours after noon	10^h	30^m
R. A. of stars on meridian	30^h	10^m
R. A of Regulus	10^h	04^m
Hour angle of Regulus	20^h	06^m

2. If, as in this case, the hour angle lies between 12^h and 24^h so that the star lies in the eastern sky, proceed as follows:

Draw a circle, N-NCP-S-N, Fig. 1, of any convenient diameter, the larger the better. The interior of this circle represents the eastern sky and the circumference represents the meridian. Draw a diameter NS parallel to the bottom of your paper to represent the eastern horizon and mark the center of it East, the right-hand end south and the left hand end North. Draw a diameter perpendicular to the horizon to represent your plumb line, the upper end representing the zenith, or point directly overhead. Divide the portion of the meridian from the south point, S, to the zenith into nine equal parts and mark the points thus found as shown in Fig. 1 on the outside of the meridian.

Now draw a diameter running down from right to left (we assume that the observer is north of the earth's equator), and making an angle with the plumb line equal to the latitude of the place. This line will represent the celestial equator and in Fig. 1 it is drawn for the place in latitude 42° N., referred to in the above example. Now draw a diameter NCP-E-SCP perpendicular to the equator to represent the earth's axis. The right-hand end of it will represent the south celestial pole and the left-hand end, the north celestial pole. Divide the portion

of the meridian from the "end" of the equator above the horizon to the north celestial pole into nine equal parts and mark the points thus found as shown in Fig. 1 on the inside of the meridian.

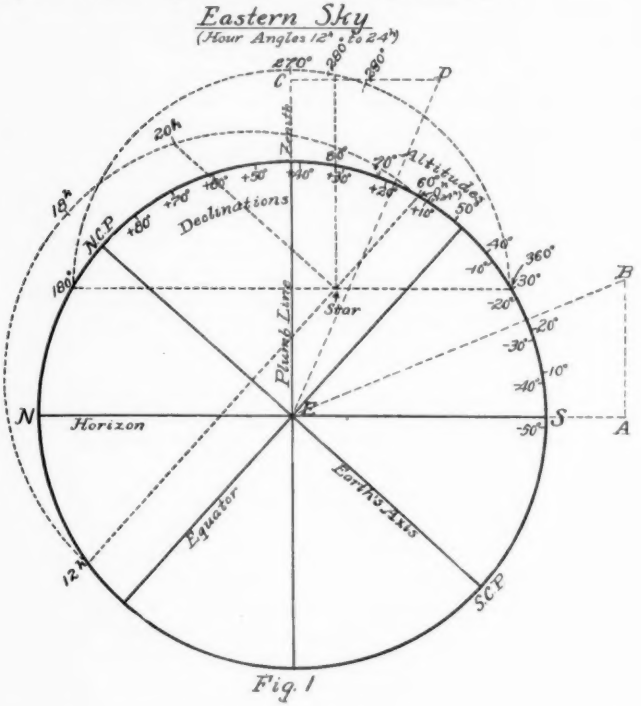

Fig. 1

The work up to this point should be done on a good grade of drawing paper and inked in, as it forms a chart that can be used over and over again for points in the latitude for which it was drawn. This permanent part of the chart is shown drawn in full lines in Fig. 1. The construction lines, which are temporary and should be drawn in lightly with a hard pencil, are shown in the figure as dotted lines. These construction lines are drawn as follows:

Lay off the star's declination, in this example $+12°$, on the meridian from the "end" of the equator above the horizon. Through the point on the meridian thus arrived at draw a line parallel to the equator. On this line as diameter and on whichever side it is convenient, draw a semicircle. Mark this 24^h at its end on the meridian above the horizon, 12^h at its end on the meridian below the horizon and 18^h at the middle of the semicircular arc as shown in the figure. Using these

figures as a guide, lay off on the semicircle the star's hour angle which in this case we have found to be about 20^h. From the point thus found drop a perpendicular upon the diameter of the semicircular arc. The foot of this perpendicular will be the star's position.

Through the star's position draw a line parallel to the horizon. Where this line cuts the meridian at the south you can read off the star's altitude directly on the outside of the meridian. In this example it is seen to be 30°, almost exactly. On the line last drawn as diameter and on whichever side it is convenient draw a semicircle, marking it 180° at its extremity on the meridian at the left, 360° at its extremity on the meridian at the right and 270° at the middle, as shown. From the star's position draw a line parallel to the plumb line until it cuts the semicircular arc. The point thus found will give you the star's azimuth, in this case 282°. Thus we have solved our problem and learned that for points in latitude 42° N. Regulus will be 12° south of east and 30° above the horizon at 10:30 P. M. on January 16.

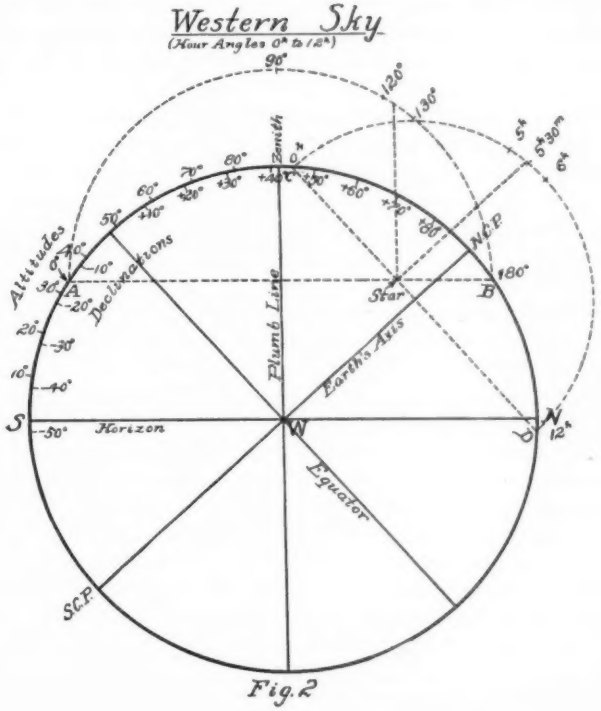

Fig. 2

The reader will also need a chart for the western sky as shown in Fig. 2. The constructions are similar to those for a star in the eastern sky, but differ in two respects:

(a) the semicircle drawn on the line parallel to the equator is marked 0^h on the meridian at the left, 12^h on the meridian at the right and 6^h in the middle as shown in Fig. 2;

(b) the semicircle drawn on the line parallel to the horizon is marked $0°$ on the meridian at the left, $180°$ on the meridian at the right and $90°$ at the middle, as shown.

We would call attention to the fact that the calculation for the hour angle is so simple that it can be performed mentally and once the permanent parts of the two charts are drawn the necessary construction can be performed in a very few minutes indeed and gives the position of a star or planet with fair accuracy.

II. *Seeing a bright object in the sky at a given place at a given date and hour, to find what star or planet it is.*

When you have estimated the azimuth and altitude of a star you can work out its declination and hour angle on the charts already drawn by a construction similar to that outlined above for finding the azimuth and altitude, but in just the reverse order.

Example. At a place in Latitude 42° N. a first magnitude star is seen at 6:30 P.M.(local time) on January 16, 33° north of west(azimuth 123°) with an altitude of 34°. What star is it?

The construction for this is carried out in Fig. 2, and the declination is found to be $+45°$ and the hour angle $5^h\ 25^m$. The steps in the construction are: lay off the altitude and draw line AB parallel to the horizon, draw semicircle on AB as diameter and lay off the azimuth, drop perpendicular on AB, draw CD parallel to the equator and read off the declination, draw semicircle on CD, draw perpendicular to CD and read off the hour angle on the semicircle.

When the hour angle has been found in this way subtract the hour angle from the right ascension of stars on the meridian at the given time. The result will be the right ascension of the star. If necessary to make subtraction possible, add 24^h to the right ascension of stars on the meridian before subtracting. If the right ascension of the star comes out greater than 24^h subtract 24^h from it.

Returning to our example, January 16 is 9 months 25 days after March 22. So we have:—

$9\times2^h+25\times4^m=18^h\ 100^m=$ R.A. of sun =	$19^h\ 40^m$
Hours after noon	$6^h\ 30^m$
R. A. of stars on the meridian	$26^h\ 10^m$
Star's hour angle	$5^h\ 25^m$
Star's right ascension	$20^h\ 45^m$

Since our construction has already shown that the declination is 45°, we now turn to our star map and look for a star of the first magnitude in R. A. 20^h 45^m, declination $+45°$. We find that these specifications fit the star Deneb in the constellation Cygnus, very nearly.

Here again the construction can be performed very quickly, giving the declination and hour angle. The right ascension can then be obtained by a simple mental calculation.

If we set out to locate a star by the method above described, and find in our calculation that the hour angle is within an hour or so of 0^h or 12^h or 24^h, it is unnecessary to carry out any construction. For the star will be within 15° east or west of the meridian and to find its position in a north and south direction we can assume it on the meridian and knowing its declination we can read its altitude directly off the chart.

On the other hand, if we see a star within a few degrees of the meridian and wish to identify it, no construction is necessary. For we know that its right ascension will be very nearly the right ascension of stars on the meridian. One can make an estimate of the correction to be applied to this from the distance the star is away from the meridian. In this way the right ascension of the star can be found, and the declination can be read off the chart at once from the estimated altitude.

If the observer is in the southern hemisphere, the only modification to be made in the method is to draw the line representing the celestial equator on the other side of the plumb line, i. e., running down from left to right for the eastern sky and down from right to left for the western sky.

In identifying stars by this method it is of course necessary to have some convenient method of estimating the altitude and azimuth of the star in question. Errors of 1° or 2°, or even a little more, will do no harm in this work, so that the following rough and ready methods, which do not require the use of any unusual appliances, are applicable.

The azimuth of a star may be conveniently measured by means of a pocket compass as follows. Hold a stick, a yard stick for example, horizontally in front of you, pointing away from you and toward the point on the horizon beneath the star. If the magnetic compass points true in your locality then if you lay a compass on the stick so that the line joining the 0 and 180 marks on the compass dial is parallel to the edge of the stick with the 0 toward you, 360° minus the reading at the north-seeking end of the needle will be the star's azimuth. If the compass points east of north in your locality you must add to the result obtained by the method just given the number of degrees that the compass points east of north. If the compass points west of north

in your locality you must subtract from the result the number of degrees that the compass points west of north. Whether the compass points east or west of north in your locality, and how much, can readily be determined by measuring the azimuth of the North Star by this method. The result will be 180° if the compass points true north.

The altitude of a star can be measured by means of a rule or yardstick as follows. Hold the stick at arm's length with the end of the thumb on a level with the eye and the stick vertical and at right angles with the arm (approximately). Turn around so that the arm points to the point on the horizon below the star. Now allow just enough of the stick to project above the end of the thumb so that you can just see the star over the end of the stick. Note how many inches of the stick projects above the end of the thumb. Measure the distance from the eye to the end of the thumb when the arm is stretched out horizontally with thumb vertical. This distance will be 24 inches, very nearly, for an adult, and of course can be measured once for all.

These two distances can then be laid off to any convenient scale as shown in Fig. 1, EA representing distance from eye to end of thumb and AB representing length of stick projecting above end of thumb. Drawing line EB, we find altitude of star to have been about 22½°. It will be found that this method will work very well for altitudes below 45°. For altitudes greater than 45° hold the arm vertically and the stick horizontally. The distance from the eye to the end of the thumb can then be laid off to any convenient scale, as shown by EC in Fig. 1. (This distance will obviously not be the same as the corresponding distance when the arm is held horizontally). Length of stick projecting beyond end of thumb can then be laid off to the same scale, as shown by CD. Drawing line ED, we find the altitude of the star to have been about 66°. The altitude having been laid off in this way, the declination and hour angle can be found by construction as already explained.

Everyone interested in the heavenly bodies ought to provide himself with the current issue of the American Nautical Almanac, which is issued annually two years in advance and can be obtained for fifteen cents a copy from the Superintendent of Documents, Government Printing Office, Washington, D. C. It contains tables of the right ascensions and declinations of the sun, moon, four visible planets and 200 stars, the Equation of Time and a great amount of other interesting information.

The planets are not marked on the star maps because they change their positions among the stars so rapidly that it would be worse than useless permanently to mark them on the map. However, one can pick their right ascensions and declinations from the Almanac and mark them in pencil on the map from time to time. Then they can be located and identified in the same way as stars.

If you wish to locate in the sky a star found on the map quite near to one or more stars with which you are familiar, of course you need only to notice on the map the distance (in degrees) and direction of the unknown star from the known star or stars, and go at once and hunt it out in the sky without any calculation at all. On the other hand, if you see a star quite near to a star or stars with which you are familiar, you need only to note the approximate distance in degrees and the approximate direction of the unknown star from the known star or stars. It requires some practice satisfactorily to estimate distances and directions in the sky. The student will be helped in estimating distances by remembering that the Pointers in the Dipper are about 5° apart, as are also Castor and Pollux. He will be helped in estimating directions by remembering that the direction in the sky toward the North Star is north, the opposite direction is of course south, and the east-west line runs at right angles to the line running from the star to the North Star. Angular distances can also be measured with very fair accuracy with the cross-staff, a simple and easily made piece of apparatus.

But when the star is not quite near to a star or stars with which the student is familiar, or when the sky is partly clouded over, it is believed that the student will find the circle diagram method herein described a considerable help either in locating or identifying a star or planet. We believe that navigators could use the method to advantage to identify bright stars appearing between the clouds on cloudy nights, when these stars are to be used for observations for position. For this purpose this method is undoubtedly more convenient than the methods given for the purpose in textbooks on Navigation (see Muir, "Navigation and Compass Deviations", p. 692). Of course, if a number of stars in the same part of the sky are being identified or located at the same time, it is necessary only to go through the construction for one or two and then apply the method suggested in the preceding paragraph to the rest.

III. *To determine the local time from the altitude of a heavenly body.*

The writer has found this graphical construction very useful in elementary classes in Astronomy for illustrating the method in use by navigators for determining the local time at a given instant by observing the altitude of a star or the sun at that instant. The graphical construction gives an approximate solution. For example, referring to Fig. 2, suppose that at a certain instant at some place in Latitude 42° N. the altitude of the star Deneb in the western sky is measured and found to be 34°. Knowing the latitude of the place, and knowing the star to be Deneb, so that we can look up the declination and right

ascension, we lay off the latitude, declination and altitude as shown in Fig. 2, and find that the hour angle of the star at the given instant must have been $5^h\ 25^m$. From the date we can calculate the right ascension of the sun as in the previous examples, and then knowing the right ascension of the star and its hour angle we find that the time of the observation was $6^h\ 30^m$ after noon.

In the case of the sun the process is even simpler, for the hour angle when found is the local apparent solar time, which is 0^h at true local noon and is measured from 0^h to 24^h. By adding or subtracting the Equation of Time for the time of the observation to or from the apparent solar time we obtain the local mean solar time. The Equation of Time may be found in the American Nautical Almanac. To obtain the standard time increase the local mean solar by the number of minutes your place is west of the standard meridian, or decrease the local mean solar time by the number of minutes your place is east of the standard meridian. If the result lies between 0^h and 12^h it is the standard time P. M. If the result lies between 12^h and 24^h by subtracting 12^h from it you obtain the standard time A. M. Thus by measuring the sun's altitude at a given instant one can find the standard time at that instant.

IV. *To find the time of rising or setting of the sun or moon or a star.*

Evidently the method outlined in the last two paragraphs for finding the time when a star or the sun is at a certain altitude can be very conveniently applied to find the time when a star, the sun, the moon or a planet is at 0° altitude in the eastern sky, i. e., rising, or at 0° altitude in the western sky, i. e., setting.

V. *To find the time of end of twilight or of beginning of dawn.*

Since dawn begins when the sun is 18° below the horizon in the eastern sky and twilight ends when the sun is 18° below the horizon in the western sky, one needs only to apply the method of the preceding paragraphs to find when the sun reaches those altitudes and he has at once the times of beginning of dawn and end of twilight. Evidently beginning of dawn and sunrise will occur at the same intervals before true local noon (when the sun crosses the local meridian) as sunset and end of twilight, respectively, occur after true local noon. So only one construction is necessary to find the times at which all four events occur on a given date.

Example. Find standard times of beginning of dawn, sunrise, sunset and end of twilight at Columbus, Ohio, Latitude 40° N., Longitude 83° W., on March 27, 1918.

On this date the standard meridian for the locality of Columbus was the 90th meridian, W. From the American Nautical Almanac for 1918 we find for March 27:

Sun's declination	+ 2½ degrees
Equation of time (to be added to the apparent time)	+ 6^m

The necessary construction is shown in Fig. 3. Having laid off the latitude and drawn the equator and laid off the declination, we find

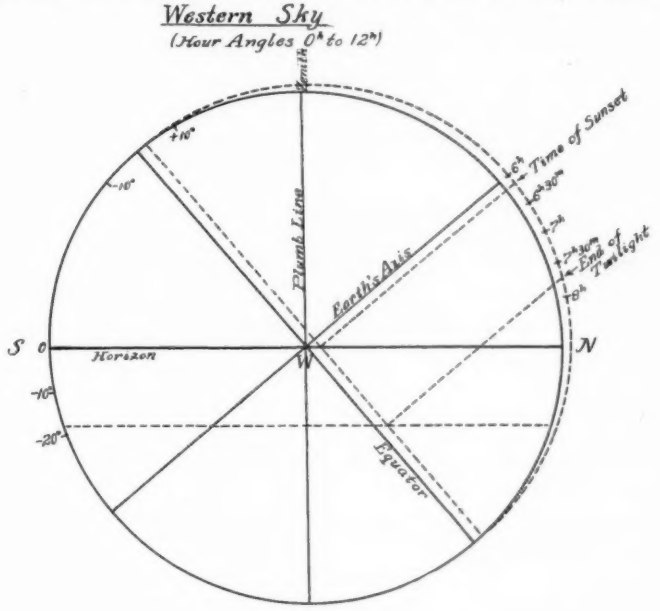

Fig. 3

that the sun's hour angles at sunset and end of twilight, respectively, are $6^h\ 10^m$ and $7^h\ 45^m$. Since sunrise and beginning of dawn occur just as much before true noon as sunset and end of twilight occur after true noon, we find local apparent times of beginning of dawn and of sunrise to be $4^h\ 15^m$ A. M. and $5^h\ 50^m$ A. M., respectively. Applying the Equation of Time, we find the local mean times of the various events. Since Columbus is 7°, or 28^m (15° is equivalent to 1^h), east of the 90th meridian W., we find the standard times simply by subtracting 28^m from the local mean times. So our results are as follows:

Columbus, Ohio, Latitude 40° N., Longitude 83° W., March 27, 1918.

	Local apparent times	Local mean times	Standard times
Beginning of dawn	$4^h\ 15^m$ A. M.	$4^h\ 21^m$ A. M.	$3^h\ 53^m$ A. M.
Sunrise	5 50 A. M.	5 56 A. M.	5 28 A. M.
Sunset	6 10 P. M.	6 16 P. M.	5 48 P. M.
End of twilight	7 45 P. M.	7 51 P. M.	7 23 P. M.

In conclusion I wish to express my appreciation to Professor H. C. Lord, Director of the Emerson McMillin Observatory, for his helpful criticism and suggestions during the preparation of this article.

The Emerson McMillin Observatory,
Columbus Ohio, April, 1918.

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"		572	"	12	"	"	4	"	12	"	of Report No. **10** *read* accompanying the Index to Reports **1** to **10**
"		578	"	27	"	"	10	"	27	"	practical *read* practiced
"		662	"	4	"	**12**	9	"	4	*After*	band *insert* joining Acidalium with Aurorae
	24	35	"	18	"	**13**	2	"	18	*For*	Hamonis *read* Hammonis
"		"	"	34	"	"	"	"	34	"	longitudes " longitude
"		42	"	5	"	"	9	"	5	"	2 " 3
"		"	"	43	"	"	"	"	43	"	Syrtis " Sabaeus
"		97	"	17	"	**14**	1	"	17	"	those " these
"		98	Table 1		"	"	2	Table 1		"	Date " Opposition
"		"	line	13	"	"	"	line	13	"	when " where
"		100	"	22	"	"	4	"	22	"	Plate II " Plates II and III
"		101	"	26	"	"	5	"	26	"	Kaiser's " Dawes'
"		"	"	28	"	"	"	"	28	"	drawing " drawings
"		242	"	38	"	**15**	7	"	38	*After*	appeared *insert* ω
"		243	"	5	"	"	8	"	5	*For*	supposed *read* superposed
"		245	"	3	"	"	10	"	3	"	early November *read* late October
"		246	"	8	"	"	11	"	8	*After*	times *insert* they
"		385	"	8	"	**16**	9	"	35	*For*	1916 *read* 1914
"		"	"	19	"	"	10	"	3	"	1916 " 1914
"		642	"	9	"	**17**	4	"	7	"	like " as
"		643	"	21	"	"	"	5	"	16	" 1200 " 1300
—		—	—		—	"	"	5	"	23	" above mentioned *read* 1916, **24** 426, Plate 27
"		643	"	36	"	"	"	"	"	31	" 1916 *read* 1914
"		646	"	30	"	"	"	8	"	27	" a " the
"		648	"	18	"	"	"	10	"	16	" a " the
"		"	"	21	"	"	"	"	"	19	*After* recorded *insert* by each observer
"		"	"	22	"	"	"	"	"	20	" visibility " as deduced
"		649	"	10	"	"	"	11	"	8	" was only in " the case of
"		650	"	6	"	"	"	12	"	6	*Omit* more

An extensive list of errata occuring in the original article in Popular Astronomy **24** 647, but which were corrected in the reprints, has been already published in **25** 148.

Vol.	**25**	563	line	34	Report	**18**	5	line	34	*After*	longitude *insert* in other years
"		564	"	4	"	"	6	"	4	*For*	14 *read* 17
"		"	"	35	"	"	"	"	35	"	it " 1917
"		570	"	8	"	**12**	"	8	"	"	preceding " following
"		"	"	9	"	"	"	"	9	"	preceding " following
"		"	"	"	"	"	"	"	"	"	following " preceding
"		"	"	30	"	"	"	"	30	"	later " latter
"		571	Table I		"	**13**	Table I			"	1915 " 1917
26		316	"	17	"	**20**	7	"	8	"	192° " 292°
"		"	"	18	"	"	"	"	9	"	258° " 285°
"		319	"	4	"	"	9	"	29	*Before*	24.96 *insert* +

TWENTY-SECOND MEETING OF THE AMERICAN ASTRONOMICAL SOCIETY.

The twenty-second meeting of the Society was held August 20 to 22, 1918, at the Harvard Observatory. Before the gathering it had been expected by many that war conditions would make the attendance so small that it would be scarcely worth while to hold the sessions. As might have been anticipated, however, the number of members of the Society residing near Cambridge, together with the staff of the Observatory, would make a respectably sized company at any time, and these with the few who are able to attend from a distance made a number which was well up to the average of previous meetings of the Society. Although many astronomers about the country are actively engaged in war work, the number of papers showed no tendency to decrease, in fact there was the greatest number of communications ever presented at a meeting of the Society. This was due primarily to two astronomical occurrences which were not affected by the war, the solar eclipse of June 8, 1918, and the appearance of the new star in Aquila. Each of these events was the occasion of about a dozen papers.

The visiting members were luxuriously housed in Standish Hall, one of the college dormitories, and it was once more shown that the ideal arrangements for a scientific meeting provide this opportunity for constant intercourse and exchange of views between those interested in similar lines of work. These conditions together with the hospitality enjoyed at the Observatory made the meeting a success in every way.

In welcoming the Society in his double capacity as host and president, Professor Pickering referred to the last previous meeting at Harvard in 1910 when so many foreign astronomers were present, and he expressed the hope that it would not be too long before similar international meetings of men of science could be held again.

In the intervals between sessions the members were afforded the opportunity to inspect the instruments and work of the Observatory, which are always a source of admiration to those who belong to less active institutions. There was a special collection of historical photographs arranged for the occasion; and other interesting features selected from the hundreds of thousands of plates now stored at Harvard, making a permanent record of the sky.

On the second afternoon the members made the trip to Wellesley, where they were guests of Professor and Mrs. Duncan. After a pleas-

ant trip of inspection about the campus and farm, they were hospitably entertained for supper in the astronomer's residence, and then repaired to the Whitin Observatory for a session with illustrated papers on the eclipse.

On the last day, after the morning session at the Harvard Observatory, the Society proceeded to the Students' Astronomical Laboratory, where Professor and Mrs. Willson entertained at luncheon. Following was a session for papers, inspection of this center of activity of student instruction in Astronomy, and especially of the opportunities for war time work under the supervision of Messrs. Willson and Stetson.

This was the last session of the meeting, but on the next day some of the members were able to accept the kind invitation to take a cruise on the yacht "Adventuress", which through the generosity of a Harvard alumnus, Mr. W. V. Moot, is being used for training in navigation, giving opportunity for observations afloat, which supplement the work in the classroom at the Students' Laboratory.

Several committee reports and items of business were considered by the Society. The report of the committee on the Beginning of the Astronomical Day—Messrs. Eichelberger, Campbell, and Frost—was read and discussed. The committee endorsed the proposal that the day begin at midnight, and that after January 21, 1925, all astronomical dates should be reckoned in this way. This change for the convenience of mariners was discussed somewhat, but the Society finally adopted the committee report with practically a unanimous vote. There was a division of opinion brought out by the proposal that the Julian Day reckoning should remain as at present, the day beginning at noon so as to avoid the discontinuity of a change, but by a vote of about two to one the Society agreed to the committee's recommendation that the whole change should be made.

In view of the uncertainty of what conditions would prevail in another year, the Council took no definite action in regard to the time and place of the next meeting, but left the matter with a committee consisting of the President, First Vice-President, and Secretary.

New members, including those who had been elected by mail since the last annual meeting, were as follows:

Leon Barritt, 150 Nassau St., New York.
Louis Bell, 120 Boylston St., Boston, Mass.
Dorothy W. Block, Harvard College Observatory, Cambridge Mass.
Henry Bourget, Observatoire de Marseille, Marseille, France.
Margherita O. Burns, Mt. Wilson Solar Observatory, Pasadena, Cal.
Harry E. Burton, U. S. Naval Observatory, Washington, D. C.
Helen N. Davis, Mt. Wilson Solar Observatory, Pasadena, Cal.
Louis Derr, Massachusetts Institute of Technology, Cambridge, Mass.
Elmer Dershem, University of Illinois Observatory, Urbana, Ill.

A. Estelle Glancy, American Optical Co., Southbridge, Mass.
Frank E. Hinkley, Harvard College Observatory, Cambridge, Mass.
W. P. Hoge, Mt. Wilson Solar Observatory, Pasadena, Cal.
Norton E. Kent, Boston University, Boston, Mass.
Clarence E. Kelley, 23 Irving St., Cambridge, Mass.
Mrs. Isabel Martin Lewis, 1921 Park Road, N. W., Washington, D. C.
Mrs. Percival Lowell, 53 State Street, Boston, Mass.
Antonia C. Maury, Hastings on Hudson, New York.
W. P. Meeker, Roland Park, Baltimore, Md.
W. F. Meggers, Bureau of Standards, Washington, D. C.
Addie L. Miller, Mt. Wilson Solar Observatory, Pasadena Cal.
Edward C. Phillips, Woodstock College, Woodstock, Md.
R. A. Porter, 861 Ostrom Ave., Syracuse, N. Y.
R. B. Potter, Naval Observatory, Washington, D. C.
Andrew Quintin, 3715 Powelton Avenue, Philadelphia, Pa.
Dorothy W. Reed, Kennebunk, Maine.
Carl L. Stearns, Dudley Observatory, Albany, N. Y.
Ambrose Swasey, Cleveland, Ohio.
Alice M. Swing, Cocoanut Grove, Florida.
Georges Van Biesbroeck, Yerkes Observatory, Williams Bay, Wis.
M. L. Zimmer, Observatory Nacional, Cordoba, Argentina.

On August 20, officers were elected for the ensuing year:

President	Edward C. Pickering
First Vice-President	Frank Schlesinger
Second Vice-President	W. W. Campbell
Secretary	Joel Stebbins
Treasurer	Annie J. Cannon
Councilors	Edwin B. Frost 1918-20
	Otto Klotz 1918-20
	E. W. Brown 1917-19
	S. A. Mitchell 1918-19

Members in attendance at the Harvard meeting were:

Sebastian Albrecht	A. Estelle Glancy	S. A Mitchell
S. I. Bailey	Asaph Hall	Margaretta Palmer
Louis Bell	Margaret Harwood	Jesse Pawling
Dorothy Block	F. Henroteau	Edward C. Pickering
Benjamin Boss	Frank E. Hinkley	Edward C. Phillips
T. C. H. Bouton	Frank C. Jordan	J. N. Poor
E. W. Brown	C. E. Kelley	Susan Raymond
A. B. Burbeck	E. S. King	Luis Rodes
Leon Campbell	Otto Klotz	Frank Schlesinger
Annie J. Cannon	Henrietta S. Leavitt	Garret P. Serviss
J. B. Coit	Mrs. Percival Lowell	Joel Stebbins
Chas. R. Cross	C. A. Robert Lundin	H. T. Stetson
Ralph E. De Lury	Chas. Y. McAteer	Elihu Thomson
Louis Derr	Antonia C. Maury	Frank W. Very
A. E. Douglass	William F. Meggers	W. R. Warner
J. C. Duncan	Willis I. Milham	Sarah F. Whiting
Alice H. Farnsworth	John A. Miller	R. W. Willson

At the final session, the following resolutions, introduced by Professor Brown, were adopted unanimously.

Resolved: That the thanks of the members of the American Astronomical Society be conveyed to the authorities of Harvard Uni-

versity for their courtesy in furnishing facilities for the meeting of the Society and, in particular, to Professor Pickering and the staff of the Harvard College Observatory for the hospitality and arrangements which have so much contributed toward the success and enjoyment of the meeting.

That an expression of appreciation of the hospitality to the members during the session at Wellesley College be sent to Professor and Mrs. Duncan, and at the Students' Astronomical Laboratory to Professor and Mrs. Wilson and Dr. Stetson.

That the Secretary be instructed to write to the several persons mentioned, enclosing a copy of the foregoing resolution.

The Society also voted expressions of thanks to President MacLaurin for his invitation to visit the Massachusetts Institute of Technology and to Mr. W. V. Moot for the opportunity to take a cruise on the yacht "Adventuress."

ABSTRACTS OF PAPERS.

THE SMITHSONIAN SOLAR CONSTANT OBSERVATORY AT CALAMA, CHILE.

By C. G. Abbot.

Simultaneous solar constant measurements in California and Algeria, pyrheliometric observations in California and Arequipa, Peru, daily comparisons of the solar constant with the distribution of radiation over the solar disk, comparisons with terrestrial magnetic variations and with terrestrial air temperatures, all having indicated and confirmed the existence of solar variability of 5 per cent or more in range and irregular periodicity over intervals of a few days or weeks, the Smithsonian Institution has established an observing station at Calama, Chile, (Lat. 22° 28′ S, Long. 68° 56′ W, Alt. 2250 m.) for observing the solar variability for a term of years.

The site, according to several years of meteorological observations, is the most cloudless in the world. For the two years, 1913-1914, the average number of wholly cloudless days is at 7 A. M. 228; 2 P. M. 206; 9 P. M. 299; and of wholly cloudy days, none. The precipitation is zero; wind seldom exceeds 3 on a scale of 12; temperature seldom falls below 0° or above 25° C. The expedition consists of A. F. Moore, Director, L. H. Abbot, Assistant, and includes bolometric, radiometric and meteorological apparatus, supplies, tools and every needful equipment for the most accurate observations of the solar constant of radiation. A site furnished by the Chile Exploration Company at Calama was occupied June 25, 1918, and work is now begun.

SPECTROSCOPIC OBSERVATIONS OF W URSAE MAJORIS.

By W. S. Adams and A. H. Joy.

A series of ten spectrograms of W Ursae Majoris taken between December 1917 and March 1918 has been used to study the elements of the system of this variable star. The principal results of the investigation are as follows:

1. The spectra of both components appear on the photographs taken near maximum, one spectrum being slightly stronger than the other.

2. The lines in both spectra are extraordinarily wide and diffuse being very difficult of measurement. The estimated spectrum is about F8p. The diffuseness of the lines is probably due mainly to the rotational effect in each star which may produce a difference of 24 km between the two limbs.

3. With the aid of the photometric observations of Russell, Shapley and van der Bilt, and the double period of 0.3336392 days given by the latter two observers, we find the following elements of the orbit:

e (assumed) $= 0.00$	$K_2 = 188 \pm 15$ km	$m_1 \sin^3 i = 0.67$
$\gamma = -5 \pm 13$ km	$a_1 \sin i = 610{,}000$ km	$m_2 \sin^3 i = 0.48$
$K_1 = 134 \pm 5$ km	$a_2 \sin i = 860{,}000$ km	$\frac{m_2}{m_1} = 0.81$

4. Assuming the "uniform" solution given by Russell the stars are ellipsoids with the same dimensions. Hence we find from $i = 77° 35'$ and the ratio of the axes of the ellipsoids:

Greatest semi-axis of each star	$= 548{,}000$ km $= 0.78$ Sun
Intermediate semi-axis of each star	$= 408{,}000$ km $= 0.58$ Sun
Polar semi-axis of each star	$= 373{,}000$ km $= 0.54$ Sun

Mass of primary $= 0.69$ Sun;	Mass of secondary $= 0.49$ Sun
Density of primary $= 2.8$ Sun;	Density of secondary $= 1.0$ Sun

The densities are the highest known in any stellar system.

5. The projected area of the two stars is about 90 per cent of that of the sun. If the surface luminosity is the same the absolute magnitude would be about 4.8 and the parallax 0″.024. If the trigonometrical parallax of 0″.012 measured at the Yerkes Observatory is accepted, the surface luminosity of the stars would be four times that of the sun.

THE ORBIT OF SIRIUS.

By Robert G. Aitken.

A new discussion of the micrometer measures of the companion to Sirius was undertaken primarily to determine the revolution period as

accurately as possible. Existing orbits, excluding two which are obviously erroneous, give periods ranging from 48.84 years to 52.20 years.

The least squares solution, based upon an observed arc 13° in excess of our complete revolution, resulted in the following set of elements:

Period	= 50.04 years	± 0.09 years	
Time of periastron passage	= 1894.133	± 0.011 "	
Eccentricity	= 0.5945	± 0.0023	
Semi-major axis	= 7″.570		
Inclination	= +43°.31	± 0°.25	1900.0
Nodal point	= 42.71	± 0 .33	
Angle between node and periastron	= 145.69	± 0 .38	

A new discussion was also made of the variation in the radial velocity of Sirius, using all available spectrographic measures. It was found that the spectrograms taken at Mount Hamilton, at Santiago, Chile, at Williams Bay, at Mount Wilson and at the Cape of Good Hope are consistent in showing a progression in the observed radial velocity corresponding closely to the progression in the radial component of the orbital velocity computed from the elements for the visual binary system given above. There are irregularities in the progression but none that cannot reasonably be accounted for by errors of observation. This confirms the conclusion reached by Campbell in 1905.

The Potsdam spectrographic measures fall into two groups which cannot, at present, be combined either with each other or with the measures made elsewhere. The hypothesis that the irregularities they show are due to perturbations in the orbit is negatived by the numerous measures made in the same period at the other observatories named.

The complete paper will be printed as a Lick Observatory Bulletin.

THE SPECTRAL CLASSIFICATION OF 3919 VISUAL BINARY STARS.

By Robert G. Aitken.

The paper gives some of the results derived from the comparison of the author's list of the 5400 close double stars as bright as 9.0 B. D. magnitude in the northern sky with the unpublished new Draper Catalogue of Stellar Spectra. The comparison was made in June, 1917, and acknowledgements are due to Director E. C. Pickering and Miss Annie J. Cannon for their great kindness in this matter.

The comparisons yielded the spectral class of 3919 of the 5400 pairs, including practically all those as bright as 8.5 B. D. magnitude. Table I shows the detailed classification of these stars and of the 605 spectroscopic binaries known (in the entire sky) in October, 1917.

TABLE I.

	0	B0	B1	B2	B3	B5	B8	B9	A0	A2	A3	A5	F0	F2
Vis. Bin.	5	8	6	12	33	28	65	173	594	342	162	121	268	144
Spec. Bin.	7	20	15	24	60	34	38	15	96	38	12	32	26	3

	F5	F8	G0	G5	K0	K2	K5	Ma	Mb	Md	Total
Vis. Bin	405	336	351	407	358	72	36	9	4	0	3919
Spec. Bin.	26	11	34	20	71	4	7	9	2	1	605

TABLE II.

	B	A	F	G	K	M	All
			NUMBERS.				
Vis. Bin. (all)	157	1251	532	1093	837	49	3919
Vis. Bin. (to 6.5)	59	142	65	83	93	18	460
Spec. Bin.	198	161	61	71	95	19	605
R. H. P. Stars	822	2755	1097	932	2531	636	8773
			PERCENTAGES.				
Vis. Bin. (all)	4	32	14	28	21	1	100
Vis. Bin. (to 6.5)	13	31	14	18	20	4	100
Spec. Bin.	33	26	10	12	16	3	100
R. H. P. Stars	9	31	13	11	29	7	100
			RESIDUALS.				
V. B. (all)—H. P.	− 5	+1	+1	+17	− 8	−6	
V. B. (6.5)—H. P.	+ 4	0	+1	+ 7	− 9	−3	
Sp. B. —H. P.	+24	−5	−3	+ 1	−13	−4	

In Table II the stars are grouped into the six chief classes of spectra, indicated by the heavy vertical rules in Table I. Better to compare the results with Pickering's tabulation of all stars as bright as 6.5 (photometric) magnitude in the Revised Harvard Photometry, the second line of the table gives separately the data for the visual binaries as bright as 6.5 B. D. magnitude. The lower part of the table puts the data into the form of percentages, the last three lines giving the residuals in the percentages.

Granting the lack of homogeneity in the data, it is still apparent that the spectroscopic binaries (which are nearly all brighter than 6.0 magnitude) are relatively most numerous among stars of Class B, while the brighter, as well as probably the fainter visual binaries, are relatively most numerous among stars of Class G.

Reasons were given for the conclusion that these results are not materially affected by the fact that the visual binaries are to a certain extent selected stars.

PERSONALITY IN THE ESTIMATION OF TENTHS.

By Sebastian Albrecht.

Personality enters in estimating the position of an index between two scale rulings. The list of percentages giving the frequency with which each tenth is represented in the estimations of an observer is known as this observer's personal scale. Below are enumerated some of the principal results of a somewhat detailed investigation of the personal scale for sixteen present and former observers of the Dudley Observatory, extending over periods of more than 20 years for some of the observers:

(a) The personal scales for different observers may differ widely from each other.

(b) For any individual observer the personal scale is remarkably constant over short and moderately long periods of time,—even up to one year.

(c) Fatigue appears not to change the personal scale appreciably. For example it remained essentially constant during five hours of continuous observing at great speed.

(d) For some observers the personal scale remained practically unchanged for 8 or 10 years, the entire period covered by the data, while for other observers it was found to undergo a gradual and more or less progressive change from year to year.

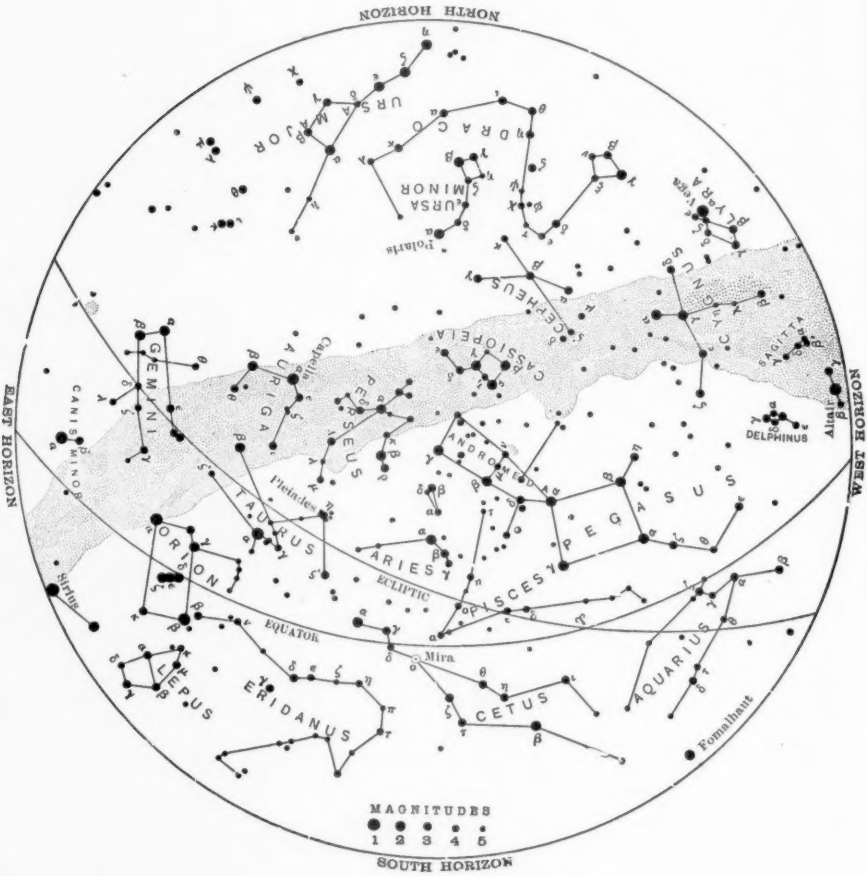
Tests were also made on specially ruled scales in order to determine the extent to which different widths of scale rulings and of index influence the estimated position of the index. The indications are that this influence, which is superimposed upon the personal tendency referred to above, is different for different observers, being very slight for some and more appreciable for other observers. Aside from the effect upon the estimated position of the index, wide lines are more difficult and troublesome to estimate. Most observers find it much easier to make estimations with moderately narrow lines—widths of the order of one-twentieth of the scale interval than with wide lines.

The investigation is being somewhat extended, especially with the view to learning to what extent observers without any previous experience in estimating tenths may acquire and hold a correct personal scale.

(*To be Continued.*)

PLANET NOTES FOR DECEMBER, 1918.

The sun will continue its motion southward until December 22, the date of the winter solstice, and will then begin its northward motion again. It will move from a position just north of Antares in Scorpio into the constellation Sagittarius.



THE CONSTELLATIONS AT 9:00 P. M. DECEMBER 1.

The phases of the moon in December will be

New Moon	Dec.	3	at 9	A.M.	C.S.T.
First Quarter		10	" 9	P.M.	"
Full Moon		17	" 1	P.M.	"
Last Quarter		24	" 12	P.M.	"

Mercury will be moving eastward more slowly than the sun and will be overtaken by the sun on December 18. On this date Mercury will be about two degrees to the north of the sun and will therefore be invisible. It will continue to drop behind the sun during the month but will not be far enough from the sun to become visible.

Venus will be moving eastward at nearly the same rate as the sun and will remain very close to the sun during the month. It will not be visible at all. Early in the year it will appear as an evening star.

Mars will still be moving eastward ahead of the sun. It will however set low in the southwest soon after sunset and will not be well situated for observation.

Jupiter will be in excellent position for observation by northern observers during the month. At the beginning of the month it will cross the meridian at about two a. m., and at the end of the month, at midnight. It will be approaching the earth and at the middle of the month will be about 400,000,000 miles away.

Saturn will be about four hours east of Jupiter. It will therefore cross the meridian early in the morning during the month of December.

Uranus will be in the southwest at sunset. It will cross the meridian about four in the afternoon.

Neptune will be between Jupiter and Saturn in the sky. It will be in the constellation Cancer in a region in which there are no bright stars.

Occultations Visible at Washington.

[*From the American Ephemeris.*]

Date 1918	Star's Name	Magnitude	IMMERSION. Washington M.T.	Angle f'm N.	EMERSION. Washington M.T.	Angle f'm N.	Duration
			h m	°	h m	°	h m
Dec. 6	266 B Sagittarii	6.1	4 49	66	6 02	247	1 13
7	27 G Capricorni	6.2	6 02	45	7 09	261	1 08
9	44 Aquarii	5.7	7 54	39	8 59	261	1 05
14	40 Arietis	6.0	5 19	75	6 24	241	1 05
16	108 Tauri	6.2	16 25	27	16 44	349	0 19
16	*n* Tauri	5.1	17 47	50	18 22	325	0 35
19	2 B Cancri	6.0	7 26	98	8 22	279	0 56
19	5 Cancri	5.9	8 44	87	9 46	295	1 02
23	*e* Leonis	5.1	17 51	95	19 07	331	1 16

Saturn's Satellites.

[From the *American Ephemeris.*]

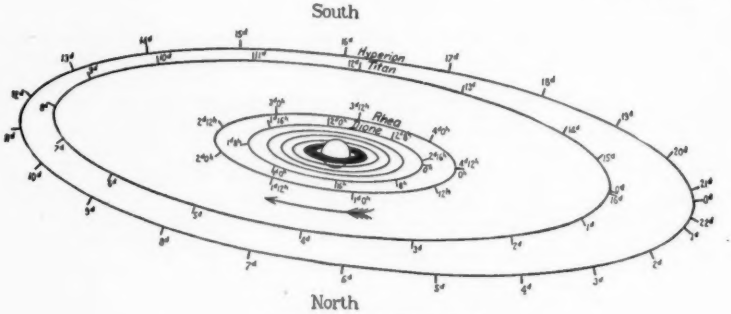
CENTRAL STANDARD TIME.

I. Mimas. Period $0^d\ 22^h.6$.

		h		h		h		h
Dec.	1	9.2 W	Dec. 9	10.5 E	Dec. 17	10.7 W	Dec. 25	10.9 E
	2	20.1 E	10	20.4 W	18	9.3 W	26	9.5 E
	3	18.7 E	11	19.1 W	19	19.2 E	27	19.4 W
	4	17.3 E	12	17.6 W	20	17.8 E	28	18.0 W
	5	16.0 E	13	16.2 W	21	16.5 E	29	16.7 W
	6	14.6 E	14	14.9 W	22	15.1 E	30	15.3 W
	7	13.2 E	15	13.5 W	23	13.7 E	31	13.9 W
	8	11.8 E	16	12.1 W	24	12.3 E		

II. Enceladus. Period $1^d\ 8^h.9$.

		h			h			h			h
Dec.	3	9.2 E	Dec.	10	5.6 E	Dec.	17	2.0 E	Dec.	23	22.4 E
	4	18.1 E		11	14.5 E		18	10.9 E		25	7.3 E
	6	2.9 E		12	23.4 E		19	19.8 E		26	16.2 E
	7	11.8 E		14	8.2 E		21	4.7 E		28	1.1 E
	8	20.7 E		15	17.1 E		22	13.5 E		29	10.0 E
										30	18.8 E



SATELLITES OF SATURN, 1918.

Apparent Orbits of the Seven Inner Satellites of Saturn at Date of Opposition, January 31, 1918, as seen in an inverting telescope.

III. Tethys. Period $1^d\ 21^h.3$.

Dec.	2	10.9 E	Dec.	10	0.1 E	Dec.	17	13.4 E	Dec.	25	2.6 E
	4	8.2 E		11	21.4 E		19	10.7 E		26	23.9 E
	6	5.5 E		13	18.8 E		21	8.0 E		28	21.9 E
	8	2.8 E		15	16.0 E		23	5.3 E		30	18.5 E

IV. Dione. Period $2^d\ 17^h.7$.

Dec.	2	21.3 E	Dec.	11	2.3 E	Dec.	19	7.4 E	Dec.	27	12.4 E
	5	15.0 E		13	20.0 E		22	1.1 E		30	6.0 E
	8	8.7 E		16	13.7 E		24	18.7 E			

V. Rhea. Period $4^d\ 12^h.5$.

Dec.	0	19.4 E	Dec.	9	20.3 E	Dec.	18	21.1 E	Dec.	27	21.9 E
	5	7.9 E		14	8.7 E		23	9.5 E		32	10.3 E

VI. Titan. Period $15^d\ 23^h.3$.

Dec.	2	16.1 W	Dec.	10	20.7 E	Dec.	18	14.7 W	Dec.	26	19.2 E

VII. Hyperion. Period $21^d\ 7^h.6$.

Dec.	10	6.7 E	Dec.	20	22.8 W	Dec.	31	10.6 W			

VIII. Iapetus. Period $79^d\ 22^h.1$.

Nov.	20	20.5 W	Dec.	10	23.8 S	Dec.	31	17.7 E			

IX. Phoebe. Period $523^d\ 15^h.6$.

		α Ph.—α Sat.	δ Ph.—δ Sat.			α Ph.—α Sat.	δ Ph.—δ Sat.
		m s	′ ″			m s	′ ″
Dec.	2	−0 32.4	+5 47	Dec.	18	−0 53.8	+7 42
	4	35.2	6 02		20	56.4	7 56
	6	37.9	6 17		22	−0 58.9	8 09
	8	40.6	6 32		24	−1 01.5	8 22
	10	43.2	6 46		26	04.0	8 34
	12	45.9	7 00		28	06.5	8 47
	14	48.5	7 14		30	09.0	8 59
	16	−0 51.2	+7 28		32	−1 11.5	+9 11

Phenomena of Jupiter's Satellites.

VISIBLE AT WASHINGTON.

[*From the American Ephemeris.*]

CENTRAL STANDARD TIME.

1918	h	m		
Dec. 1	14	40	III	Ec. D.
2	7	29	II	Ec. D.
	11	36	II	Oc. R.
	15	34	I	Sh. I.
	16	16	I	Tr. I.
	17	48	I	Sh. E.
	18	31	I	Tr. E.
3	7	4	IV	Tr. I.
	9	13	IV	Tr. E.
	12	41	I	Ec. D.
	15	39	I	Oc. R.
4	10	02	I	Sh. I.
	10	42	I	Tr. I.
	12	17	I	Sh. E.
	12	57	I	Tr. E.
5	7	10	I	Ec. D.
	7	33	III	Tr. I.
	8	01	III	Sh. E.
	10	05	I	Oc. R.
	10	44	III	Tr. E.
6	6	45	I	Sh. E.
	7	23	I	Tr. E.
7	14	58	II	Sh. I.
	16	12	II	Tr. I.
	17	39	II	Sh. E.
	18	53	II	Tr. E.
9	10	03	II	Ec. D.
	13	52	II	Oc. R.
	17	27	I	Sh. I.
10	14	35	I	Ec. D.
	17	24	I	Oc. R.
11	6	58	II	Sh. E.
	8	02	II	Tr, E.
	9	11	IV	Ec. D.
	10	58	IV	Ec. R.
	11	56	I	Sh. I.
	12	27	I	Tr. I.
	14	01	IV	Oc. D.
	14	10	I	Sh. E.
	14	41	I	Tr. E.
	16	10	IV	Oc. R.
12	8	53	III	Sh. I.
	9	04	I	Ec. D
	10	53	III	Tr. I.
	11	50	I	Oc. R.
	12	01	III	Sh. E.
	14	04	III	Tr. E.
13	6	24	I	Sh. I.
	6	53	I	Tr. I.
	8	39	I	Sh. E.
	9	08	I	Tr. E.
14	6	16	I	Oc. R.
	17	34	II	Sh. I.

1918	h	m		
Dec. 16	12	38	II	Ec. D.
	16	07	II	Oc. R
17	16	29	I	Ec. D.
18	6	52	II	Sh. I.
	7	36	II	Tr. I.
	9	34	II	Sh. E.
	10	18	II	Tr. E.
	13	50	I	Sh. I.
	14	11	I	Tr. I.
	16	04	I	Sh. E.
	16	25	I	Tr. E.
19	10	58	I	Ec. D.
	12	52	III	Sh. I.
	13	34	I	Oc. R.
	14	11	III	Tr. I.
	16	01	III	Sh. E.
	17	21	III	Tr. E.
20	8	18	I	Sh. I.
	8	36	I	Tr. I.
	10	33	I	Sh. E.
	10	51	I	Tr. E.
21	5	27	I	Ec. D.
	8	00	I	Oc. R.
22	5	17	I	Tr, E.
23	6	47	III	Oc. R.
	15	13	II	Oc. D.
25	9	29	II	Sh. I.
	9	51	II	Tr. I.
	12	11	II	Sh. E.
	12	33	II	Tr. E.
	15	44	I	Sh. I.
	15	54	I	Tr. I.
	17	59	I	Sh. E.
	18	09	I	Tr. E.
26	12	53	I	Ec. D.
	15	18	I	Oc. R.
	16	51	III	Sh. I.
	17	26	III	Tr. I.
27	7	27	II	Oc. R.
	10	12	I	Sh. I.
	10	20	I	Tr. I.
	12	27	I	Sh. E.
	12	35	I	Tr. E.
28	6	19	IV	Oc. R.
	7	21	I	Ec. D.
	9	43	I	Oc. R.
29	4	41	I	Sh. I.
	4	46	I	Tr. I.
	6	56	I	Sh. E.
	7	00	I	Tr. E.
30	6	37	III	Ec. E.
	10	2	III	Oc. R.
	17	47	II	Ec. D.

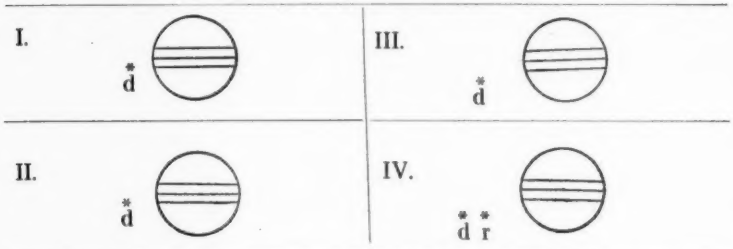
Note:—I., denotes ingress; E., egress; D., disappearance; R., reappearance; Ec., eclipse; Oc., occultation; Tr., transit of the satellite; Sh., transit of the shadow.

Satellites of Jupiter, 1918.

GREENWICH MEAN TIME.

DECEMBER

Phases of the Eclipses of the Satellites for an Inverting Telescope.



Configurations at 17h 45m for an Inverting Telescope.

Day	West	East
1	·2 ·1·3 ○	·4
2	○ ·21 ·4 ·3	
3	·4 ·1 ○ ·2 ·3	
4	○ 1· ·4 ·2 ○ ·3	
5	·4 ·2 ·3 ○ ·1	
6	·4 ·3 ·1 ○ ·2	
7	·4 ·3 ○ ·2 ·1	
8	·4 ·2 ·1 ·3 ○	
9	·4 ○ ·1 ·3	·2 ●
10	·4 ·1 ○ ·2 ·3	
11	·2 ○ ·1 ·4 ·3	
12	○ 3· ·2 ○ ·4	·1 ●
13	·3 ·1 ○ ·2 ·4	
14	·3 ○ ·2 ·1 ·4	
15	·2 ·1 ·3 ○ ·4	
16	○ ·2 ·1 ·3 ·4	
17	·1 ○ ·1 ·3 ·4	
18	·2 ○ ·1 ·3 ·4	
19	·2 ·3 ○ ·4	·1 ●
20	·3 ·4 ·1 ○ ·2	
21	·4 ·3 ○ ·12	
22	·4 ·2 ·3 ·1 ○	
23	·4 ·2 ○ ·3 ·1	
24	·4 ·1 ○ ·2 ·3	
25	○ 2. ·4 ○ ·1 ·3	
26	·4 ·2 ○ ·1 ·3	
27	○ 1· ·3 ·4 ○ ·2	
28	·3 ○ ·1 ·4 ·2	
29	·3 ·2 ·1 ○ ·4	
30	·2 ○ ·3 ·1 ·4	
31	·1 ○ ·2 ·3 ·4	

VARIABLE STARS.

Minima of Variable Stars of Short Period.

[Calculated by Julia M. Hawkes and Frank M. Exner at Goodsell Observatory.]

Given to the nearest hour in Greenwich mean time; to obtain Eastern Standard time subtract 5h; Central Standard 6h; etc.

Star	R. A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of minima in 1918 December							
	h m	° ′		d h	d	h	d	h	d	h	d	h
SY Androm.	0 08.0	+43 09	9.5—13.0	34 21.8					22	13		
RT Sculptor.	31.5	−26 13	9.6—10.5	0 12.3	3	19;	11	11;	19	3;	26	19
UU Androm.	38.5	+30 24	10.7—11.9	1 11.7	2	14;	10	0;	17	11;	24	21
U Cephei	0 53.4	+81 20	7.0— 9.0	2 11.8	4	17;	12	5;	19	16;	27	3
Z Persei	2 33.7	+41 46	9.4—12	3 01.4	5	3;	11	6;	23	11;	29	14
TW Cassiop.	37.6	+65 19	8.2— 9.0	1 10.3	5	6;	12	9;	19	12;	26	15
RY Persei	39.0	+47 43	8.0—10.3	6 20.7	1	22;	8	19;	22	12;	29	9
RZ Cassiop.	39.9	+69 13	6.9— 8.1	1 04.7	5	6;	12	10;	19	14;	26	18
TX Cassiop.	44.4	+62 22	9.4—10.1	2 22.2	4	9;	13	3;	21	22;	30	17
ST Persei	53.7	+38 47	8.5—10.5	2 15.6	7	9;	15	17;	23	16;	31	15
RX Cassiop.	2 58.8	+67 11	8.6— 9.1	32 07.6			10	8				
Algol	3 01.7	+40 34	2.3— 3.5	2 20.8	3	17;	9	11;	20	22;	26	16
RT Persei	16.7	+46 12	9.5—11.5	0 20.4	4	23;	11	18;	18	13;	25	8
λ Tauri	55.1	+12 12	3.3— 4.2	3 22.9	5	18;	13	15;	21	13;	29	11
RW Tauri	3 57.8	+27 51	7.1—<11	2 18.5	8	0;	16	7;	24	15		
RV Persei	4 04.2	+33 59	9.5—11.0	1 23.4	1	6;	9	3;	17	1;	24	22
RW Persei	13.3	+42 04	8.8—11.0	13 04.8	3	23;	17	3;	30	8		
SZ Tauri	31.4	+18 20	7.2— 7.7	3 03.6	1	5;	10	15;	20	2;	29	13
RS Cephei	4 48.6	+80 06	9.5—12.0	12 10.1	6	14;	19	0;	31	11		
TT Aurigae	5 02.8	+39 27	7.8— 8.7	0 16.0	3	6;	9	22;	23	6;	29	22
RY Aurigae	11.5	+38 13	10.7—11.7	2 17.5	7	14;	15	18;	23	23		
RZ Aurigae	42.9	+31 40	10.6—13.3	3 00.3	2	3;	18	3;	20	4;	26	5
SV Tauri	45.8	+28 05	9.4—11.0	2 04.0	5	16;	14	9;	23	1;	31	17
Z Orionis	50.2	+13 40	9.7—10.7	5 04.9			10	18;	21	4;	31	14
SV Gemin.	54.6	+24 28	9.8—<11	4 00.2	4	4;	12	4;	20	5;	28	5
RW Gemin.	5 55.4	+23 08	9.5—11.0	2 20.8	5	6;	11	0;	22	11;	28	4
U Columbae	6 11.2	−33 03	9.2—10.0	2 19.2	6	6;	11	20;	17	11;	28	15
SX Gemin.	22.0	+20 37	10.8—11.5	1 08.8	3	21;	12	2;	20	7;	28	11
RW Monoc.	29.3	+ 8 54	9.0—10.8	1 21.7	7	0;	14	15;	22	6;	29	21
RX Gemin.	43.6	+33 21	8.8— 9.6	12 05.0	9	17			21	22		
RU Monoc.	6 49.4	− 7 28	9.8—10.5	0 21.5	3	7;	10	11;	17	15;	24	19
R Can. Maj.	7 14.9	−16 12	5.8— 6.4	1 03.3	4	23;	11	18;	18	14;	25	9
RY Gemin.	21.7	+15 52	8.9—<10	9 07.2	2	20;	12	3;	21	10;	30	18
Y Camelop.	27.6	+76 17	9.5—12	3 07.3	4	10;	11	0;	24	6;	30	20
TX Gemin.	30.3	+17 8	10.0—11.9	2 19.2	3	15;	12	0;	20	10;	28	20
RR Puppis	43.5	−41 08	9.4—10.7	6 10.3	6	6;	12	6;	25	13;	31	23
V Puppis	7 55.4	−48 58	4.1— 4.8	1 10.9	1	23;	9	6;	23	19;	31	2
X Carinae	8 29.1	−58 53	7.9— 8.7	0 13.0	3	1;	11	4;	19	7;	27	10
S Cancri	8 38.2	+19 24	8.2—10	9 11.6	5	3;	14	14;	24	2		
RX Hydrae	9 00.8	− 7 52	9.1—10.5	2 6.8	6	15;	13	11;	20	8;	27	4
S Velorum	29.4	−44 46	7.8— 9.3	5 22.4	5	18;	11	17;	23	14;	29	12
Y Leonis	9 31.1	+26 41	9.3—11.2	1 16.5	4	11;	11	5;	24	16;	31	10
RR Velorum	10 17.8	−41 36	10.0—10.9	1 20.5	2	19;	10	5;	17	15;	25	1
SS Carinae	10 54.2	−61 23	12.2—12.8	3 07.2	2	12;	9	2;	22	17;	28	21
ST Urs. Maj.	11 22.4	+45 44	6.7— 7.2	8 19.2	5	19;	14	14;	23	10		
RW Urs. Maj.	35.4	+52 34	10.3—11.4	7 07.9	5	8;	12	16;	20	0;	27	8
Z Draconis	11 39.8	+72 49	9.9—13.6	1 08.6	3	12;	10	7;	17	2;	23	21
RZ Centauri	12 55.6	−64 05	8.5— 8.9	1 21.0	6	18;	14	6;	21	18;	29	6
RS Can. Ven.	13 06.3	+36 28	7.5—12.5	4 19.1			10	3;	19	17;	29	8
SS Centauri	13 07.2	−63 37	8.8—10.4	2 11.5	4	21;	12	7;	19	18;	27	4
δ Librae	14 55.6	− 8 07	4.8— 6.2	2 07.9	2	17;	9	16;	23	15;	30	15

Minima of Variable Stars of Short Period—Continued.

Star	R. A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of minima in 1918 December
	h m	° ′		d h	d h; d h; d h; d h
U Coronae	15 14.1	+32 01	7.6— 8.7	3 10.9	5 5; 12 3; 19 0; 25 22
TW Draconis	32.4	+64 14	7.3— 8.9	2 19.3	1 3; 9 13; 17 23; 26 9
SS Librae	15 43.4	−15 14	9.3—11.5	0 18.4	7 22; 15 14; 23 6; 30 22
SW Ophiuchi	16 11.1	− 6 44	9.2—10.0	2 10.7	7 7; 14 15; 21 23; 29 7
SX Ophiuchi	12.6	− 6 25	10.5—11.2	2 01.5	7 20; 16 2; 24 8
R Arae	31.1	−56 48	6.8— 7.9	4 10.2	9 7; 18 4; 20 0
TT Herculis	16 49.9	+17 00	8.9— 9.3	20 18.1	2 13; 13 15; 23 7
TU Herculis	17 09.8	+30 50	9.5—12	2 06.4	2 14; 9 10; 23 0; 29 19
U Ophiuchi	11.5	+ 1 19	6.0— 6.7	0 20.1	8 14; 17 0; 25 9
u Herculis	13.6	+33 12	4.6— 5.4	2 01.2	2 14; 8 18; 21 1; 27 5
TX Herculis	15.4	+42 00	8.3— 9.0	1 00.7	2 10; 9 15; 24 1; 31 6
RV Ophiuchi	29.8	+ 7 19	9. —12	3 16.5	4 14; 11 23; 19 8; 26 17
SZ Herculis	36.0	+33 01	9.5—10.3	0 19.6	3 5; 11 9; 19 14; 27 18
TX Scorpii	48.6	−34 13	7.5— 8.2	0 22.6	4 7; 11 20; 19 9; 26 22
UX Herculis	49.7	+16 57	8.8—10.5	1 13.2	2 5; 9 23; 17 17; 25 10
Z Herculis	53.6	+15 09	7.1— 7.9	3 23.8	2 7; 10 7; 18 7; 26 6
WX Sagittae	53.6	−17 24	9.2—10.8	2 03.1	4 8; 12 21; 21 9; 29 22
WY Sagittae	17 54.9	−23 1	9.5—10.6	4 16.0	8 23; 18 7; 27 15
SX Draconis	18 03.0	+ 58 23	9.3—10.5	5 04.1	11 23; 22 7
RS Sagittarii	11.0	−34 08	5.9— 6.3	2 10.0	6 10; 13 16; 20 22; 28 4
V Serpentis	11.1	−15 34	9.5—11.1	3 10.9	3 0; 9 22; 23 17; 30 15
RZ Scuti	21.1	− 9 15	7.4— 8.3	15 03.2	11 11; 26 14
RZ Draconis	21.8	+58 50	9.5—10.2	0 13.2	2 11; 9 15; 23 22; 31 2
RX Herculis	26.0	+12 32	7.0— 7.6	0 21.3	5 9; 12 12; 19 15; 26 18
SX Sagittarii	39.7	−30 36	8.7— 9.8	2 01.8	8 2; 16 9; 24 17
RR Draconis	40.8	+62 34	9.3—13	2 19.9	7 18; 16 6; 24 18
RS Scuti	43.7	−10 21	9.3—10.3	0 15.9	6 23; 13 14; 20 6; 26 21
β Lyrae	46.4	+33 15	3.4— 4.1	12 21.8	13 5; 26 2
U Scuti	18 48.9	−12 44	9.1— 9.6	0 22.9	7 9; 15 0; 22 15; 30 7
RX Draconis	19 01.1	+58 35	9.3—10.2	1 21.4	8 5; 15 19; 23 9; 30 23
RV Lyrae	12.5	+32 15	11. —12.8	3 14.4	6 21; 14 2; 21 6; 28 11
RS Vulpec.	13.4	+22 16	6.9— 8.0	4 11.4	3 13; 12 12; 21 11; 30 11
U Sagittae	14.4	+19 26	6.5— 9.0	3 09.1	2 21; 9 15; 23 4; 29 22
Z Vulpec.	17.5	+25 23	7.3— 8.5	2 10.9	5 9; 12 18; 20 3; 27 11
TT Lyrae	24.3	+41 30	9.4—11.6	5 05.8	2 5; 7 11; 17 22; 28 10
UZ Draconis	26.1	+68 44	9.0— 9.8	1 15.1	2 15; 9 3; 22 5; 28 17
SY Cygni	19 42.7	+32 28	10 —12	6 00.2	2 12; 18 12; 20 12; 26 13
WW Cygni	20 00.6	+41 18	9.3—13.4	3 07.6	6 16; 13 7; 19 22; 26 13
SW Cygni	03.8	+46 01	9. —11.7	4 13.8	6 13; 15 16; 24 20
VW Cygni	11.4	+34 12	9.8—11.8	8 10.3	1 12; 9 22; 18 9; 26 19
RW Capric.	12.2	−17 59	8.8—10.6	3 09.4	1 22; 8 17; 22 6; 29 1
UW Cygni	19.6	+42 55	10.5—13	3 10.8	5 4; 12 2; 18 23; 25 21
V Vulpec.	32.3	+26 15	8.2—9.8	37 19.0	
W Delphini	33.1	+17 56	9.4—12.1	4 19.4	9 7; 18 22; 28 13
RR Delphini	38.9	+13 35	10.5—11.8	4 14.4	3 20; 13 1; 22 5; 31 10
Y Cygni	48.1	+34 17	7.1— 7.9	1 12.0	7 8; 14 20; 22 8; 29 19
WZ Cygni	49.3	+38 27	9.9—10.8	0 14.0	2 6; 9 20; 17 11; 25 1
RR Vulpec.	20 50.5	+27 32	9.6—11.0	5 01.2	5 18; 15 20; 25 23
VV Cygni	21 02.3	+45 23	12.1—13.8	1 11.4	2 16; 10 1; 17 11; 24 20
AE Cygni	09.0	+30 20	10.8—11.4	0 23.3	8 8; 18 0; 27 17
RY Aquarii	14.8	−11 14	8.8—10.4	1 23.2	7 17; 15 14; 23 10; 31 7
UZ Cygni	55.2	+43 52	8.9—11.6	31 07.3	13 22
RT Lacertae	21 57.4	+43 24	9.1—10.5	5 01.7	2 8; 12 12; 22 15
RW Lacertae	22 40.6	+49 08	10.2—11.2	5 04.4	1 1; 6 6; 16 14; 26 23
TT Androm.	23 08.7	+45 36	11.3—12.6	2 18.4	7 13; 15 20; 24 3
Y Piscium	29.3	+ 7 22	9.0—12.0	3 18.3	1 5; 8 17; 23 19; 31 8
TW Androm.	23 58.2	+32 17	8.6—11.5	4 02.9	7 3; 15 9; 23 14; 31 20

Maxima of Variable Stars of Short Period.

[Calculated by Julia M. Hawkes at Goodsell Observatory.]

Given to the nearest hour in Greenwich mean time. To obtain Eastern standard time subtract 5h; Central standard time 6h; etc.

Star	R. A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of maxima in 1918. December
	h m	° ′		d h	d h; d h; d h; d h
SX Cassiop.	0 05.5	+54 20	8.6— 9.2	36 13.7	6 14
SY Cassiop.	0 09.8	+57 52	9.3— 9.9	4 1.7	4 15; 12 19; 20 22; 29 1
RR Ceti	1 27.0	+ 0 50	8.3— 9.0	0 13.3	8 17; 16 10; 24 4; 31 22
RW Cassiop.	1 30.7	+57 15	8.9—11.0	14 19.2	3 17; 18 12
V Arietis	2 09.6	+11 46	8.3— 9.0	0 23.8	5 8; 13 7; 21 5; 29 4
SU Cassiop.	2 43.0	+68 28	6.5— 7.0	1 22.8	1 20; 9 15; 17 10; 25 5
TU Persei	3 01.8	+52 49	11.4—12.2	0 14.6	1 11; 8 17; 23 7; 30 14
RW Camelop.	3 46.2	+58 21	8.2— 9.4	16 00.0	9 25
SX Persei	4 10.2	+41 27	10.4—11.2	4 07.0	1 16; 10 6; 18 20; 27 10
SV Persei	42.8	+42 07	8.8— 9.6	11 03.1	9 9; 20 12; 31 15
RX Aurigae	4 54.5	+39 49	7.2— 8.1	11 15.0	3 8; 14 23; 26 14
SX Aurigae	5 04.6	+42 02	8.0— 8.7	1 12.8	7 14; 14 20; 22 12; 30 4
SY Aurigae	05.5	+42 41	8.4— 9.5	10 03.3	10 21; 21 1; 31 4
Y Aurigae	21.5	+42 21	8.6— 9.6	3 20.6	6 15; 14 8; 22 2; 29 19
RZ Gemin.	5 56.6	+22 15	9.1—10.0	5 12.7	1 13; 12 15; 23 16; 29 5
RS Orionis	6 16.5	+14 44	8.2— 8.9	7 13.6	1 6; 8 20; 23 23; 31 13
T Monoc.	19.8	+ 7 08	5.7— 6.8	27 00.3	23 5
RT Aurigae	23.0	+30 33	5.1— 6.0	3 17.5	2 11; 9 22; 17 9; 24 20
RZ Camelop.	23.7	+67 06	11.0—13.0	0 11.5	4 2; 11 7; 18 12; 25 17
W Gemin.	29.2	+15 24	6.7— 7.5	7 22.0	6 9; 14 7; 22 5; 30 3
ζ Gemin.	6 58.2	+20 43	3.7— 4.3	10 03.7	3 16; 13 19; 23 23
RU Camelop.	7 10.9	+69 51	8.5— 9.8	22 06.5	12 9
RR Gemin.	7 15.2	+31 04	10.0—11.5	0 09.5	4 9; 12 8; 20 7; 28 5
V Carinae	8 26.7	−59 47	7.4— 8.1	6 16.7	1 10; 8 3; 21 12; 28 5
T Velorum	8 34.4	−47 01	7.6— 8.5	4 15.3	7 5; 16 11; 25 18
V Velorum	9 19.2	−55 32	7.5— 8.2	4 08.9	8 10; 17 3; 25 21
Z Leonis	9 46.4	+27 22	7.9— 9.6	59 0.00	27
RR Leonis	10 02.1	+24 29	9.1—10.1	0 10.9	1 7; 8 2; 21 16; 28 11
SU Draconis	11 32.2	+67 53	8.9— 9.6	0 15.8	1 8; 7 23; 21 4; 27 18
S Muscae	12 07.4	−69 36	6.4— 7.3	9 15.8	5 22; 15 14; 25 6
SW Draconis	12.8	+70 04	8.8— 9.6	0 13.7	2 16; 10 16; 18 15; 26 14
T Crucis	15.9	−61 44	6.8— 7.6	6 17.6	7 13; 14 7; 21 1; 27 18
R Crucis	18.1	−61 04	6.8— 7.9	5 19.8	1 20; 7 16; 19 7; 25 3
S Crucis	12 48.4	−57 53	6.5— 7.6	4 16.6	2 11; 11 20; 21 5; 30 14
W Virginis	13 20.9	− 2 52	8.7—10.4	17 06.5	3 0 20 7
SS Hydrae	25.0	−23 08	7.4— 8.1	8 4.8	1 20; 10 0; 18 5; 26 10
RV Urs. Maj.	13 29.4	+54 31	9.2— 9.9	0 11.2	5 13; 12 13; 19 14; 26 14
ST Virginis	14 22.5	− 0 27	10.3—11.4	0 09.9	6 19; 17 0; 25 5
V Centauri	25.4	−56 27	6.4— 7.8	5 11.9	3 10; 8 22; 19 21; 30 21
RS Bootis	29.3	+32 11	8.9—10.0	0 09.1	5 2; 12 15; 20 4; 27 17
RU Bootis	14 41.5	+23 44	12.8—14.3	0 11.9	7 14; 15 0; 22 10; 29 20
R Triang. Austr.	15 10.8	−66 08	6.7— 7.4	3 09.3	1 2; 7 20; 21 10; 28 4
S Triang. Austr.	15 52.2	−63 29	6.4— 7.4	6 07.8	6 13; 12 21; 19 5; 25 13
S Normae	16 10.6	−57 39	6.6— 7.6	9 18.1	6 5; 15 23; 25 17
RW Draconis	33.7	+58 03	9.6—10.8	0 10.6	6 3; 14 23; 23 20
RV Scorpii	16 51.8	−33 27	6.7— 7.4	6 01.5	2 21; 8 23; 21 2; 27 3
X Sagittarii	17 41.3	−27 48	4.4— 5.0	7 00.3	5 14; 12 15; 19 15; 26 15
Y Ophiuchi	47.3	− 6 07	6.1— 6.5	17 02.9	17 16
W Sagittarii	17 58.6	−29 35	4.3— 5.1	7 14.3	6 16; 14 7; 21 21; 29 11
Y Sagittarii	18 15.5	−18 54	5.4— 6.2	5 18.6	1 18; 13 7; 19 2; 24 20
U Sagittarii	26.0	−19 12	6.5— 7.3	6 17.9	1 8; 8 2; 21 14; 28 8
Y Scuti	32.6	− 8 27	8.7— 9.2	10 08.3	7 16; 18 1; 28 9
Y Lyrae	18 34 2	+43 52	11.3—12.3	0 12.1	3 7; 9 8; 21 10; 27 10

Maxima of Variable Stars of Short Period—Continued.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of maxima in 1918. December							
	h m	° ′		d h	d	h	d	h	d	h	d	h
RZ Lyrae	18 39.9	+32 42	9.9—11.2	0 12.3	7	2;	13	5;	25	2;	31	15
RT Scuti	44.1	−10 30	9.1— 9.7	0 11.9	6	2;	12	1;	23	23;	29	21
κ Pavonis	18 46.6	−67 22	3.8— 5.2	9 02.2	1	21;	10	23;	20	1;	29	3
U Aquilae	19 24.0	− 7 15	6.2— 6.9	7 00.6	7	8;	14	9;	21	10;	28	10
XZ Cygni	30.4	+56 10	8.6— 9.3	0 11.2	3	23;	10	23;	24	23;	31	23
U Vulpec.	32.2	+20 07	6.5— 7.6	7 23.5	4	22;	12	21;	20	21;	28	20
SU Cygni	40.8	+29 01	6.2— 7.0	3 20.3	4	12;	12	5;	19	21;	27	14
η Aquilae	47.4	+ 0 45	3.7— 4.5	7 04.2	3	20;	11	0;	18	4;	25	9
S Sagittae	51.5	+16 22	5.6— 6.4	8 09.2	4	20;	13	5;	21	15;	30	0
X Vulpec.	19 53.3	+26 17	9.5—10.5	6 07.7	3	15;	9	22;	22	14;	28	21
X Cygni	20 39.5	+35 14	6.0— 7.0	16 09.3			11	1;			27	10
T Vulpec.	47.2	+27 52	5.5— 6.1	4 10.5	3	10;	12	7;	21	4;	30	1
WY Cygni	52.3	+30 03	9.6—10.4	0 13.5	1	3;	7	21;	21	8;	28	1
RV Capric.	55.9	−15 37	9.2—10.1	0 10.7	5	0;	11	17;	25	4;	31	21
TX Cygni	20 56.4	+42 12	8.5— 9.7	14 17.4	3	23;			18	16		
VY Cygni	21 00.4	+39 34	8.8— 9.5	7 20.6	7	7;	15	4;	23	0;	30	21
SW Aquarii	10.2	− 0 20	9.9—10.8	0 11.0	4	10;	11	8;	18	5;	31	23
VZ Cygni	21 47.7	+42 40	8.2— 9.2	4 20.7	2	6;	11	23;	21	17;	31	10
Y Lacertae	22 05.2	+50 33	9.1— 9.6	4 07.8	4	12;	13	4;	21	19;	30	11
δ Cephei	25.5	+57 54	3.7— 4.6	5 08.8	2	5;	7	14;	18	7;	23	16
Z Lacertae	36.9	+56 18	8.2— 9.0	10 21.1	7	7;	18	4;	29	1		
RR Lacertae	37.5	+55 55	8.5— 9.2	6 10.1	4	9;	10	19;	23	15;	30	1
V Lacertae	44.5	+55 48	8.5— 9.5	4 23.6	1	4;	11	4;	21	3;	31	2
X Lacertae	22 45.0	+55 54	8.2— 8.6	5 10.7	5	18;	11	5;	22	2;	27	13
SW Cassiop.	23 03.7	+58 11	9.2— 9.7	5 10.6	4	17;	10	4;	21	1;	26	12
RS Cassiop.	32.6	+61 52	9.0—11.0	6 07.1	1	7;	7	14;	20	4;	26	11
RY Cassiop.	47.2	+58 11	9.3—11.8	12 03.4	4	12;	16	15;	28	19		
V Cephei	23 51.7	+82 38	6.0—7.0	0 23.9	1	2;	11	2;	21	1;	31	1

NOTES FOR OBSERVERS.

Monthly Report of the American Association of Variable Star Observers, September-October, 1918.

The Annual Meeting of the Association will be held at the Harvard College Observatory, Cambridge, Mass., Saturday, November 23, and not November 16 as previously reported. A large attendance is desired as many important matters are to be discussed.

The Association has been fortunate in being able to secure a splendid 5″ refractor with the amount so generously donated for that purpose by the American Association for the Advancement of Science. The glass has been tested by Mr. Leon Campbell and will soon be placed in the hands of an observer who will be pledged to make good use of it.

The Marquis Ginori, of Florence, Italy, who is now at the Front, contributes valuable observations of the Nova Aquilae to this report under the abbreviation "Gi". We also welcome observations from Mr. Frijlinck of Deventer, Holland, designated "Fl".

Messrs. Bouton, Dawson, Luyten, and McAteer contribute lists of exceptional merit this month.

VARIABLE STAR OBSERVATIONS, Sept.-Oct., 1918.

Aug. 0 = 2421806

001046
X Androm.

J.D.	Est.	Obs.
242		
1864.6	13.8	B

001032
S Sculptoris

1790.8	12.4	δ
1805.6	13.0	
08.7	13.2	
11.8	12.8	
14.6	12.8	
17.6	12.9	

001620
T Ceti

1806.5	6.2	Lt
19.5	6.1	

001726
T Androm.

1839.7	11.4	B
56.6	10.4	
59.6	9.8	M
66.6	10.1	Wh

001755
T Cassiop.

1782.4	8.4	Lt
97.4	8.3	
1806.5	8.2	
19.4	8.0	
44.6	7.8	B
60.8	8.1	M
61.7	7.6	B

001909
S Ceti

1791.8	7.9	δ
1806.5	8.5	Lt
11.9	8.1	δ
17.8	8.5	
37.4	9.6	Pe
49.7	10.3	M

001838
R Androm.

1760.5	12.3	Lt
75.5	11.7	
87.4	11.0	
94.5	10.5	
1800.5	10.1	
05.5	9.6	
07.3	9.5	Pe
12.4	9.1	Lt
17.3	8.5	Pe
24.3	7.3	
30.3	7.2	
35.3	6.8	
44.6	6.9	B
45.6	6.7	Pt
49.6	6.9	
50.8	7.2	M
66.6	6.9	Hu

*002438*a
T Sculptoris

J.D.	Est.	Obs.
242		
1790.8	9.1	δ
1805.7	9.0	
11.8	9.3	
14.6	9.4	
17.7	9.4	

*002438*b
RR Sculptoris

1790.8	12.7	δ
1811.8	12.7	
14.7	12.7	
17.7	12.7	

002546
T Phoenicis

1790.8	14.2	δ
1811.8	14.0	
16.7	14.2	

002614
T Piscium

1850.8	10.0	M

002833
W Sculptoris

1790.8	13.0	δ
1811.8	13.2	
14.7	12.6	
17.7	12.6	

003179
Y Cephei

1807.5	10.2	Lt
19.5	9.4	
39.7	9.1	B
56.6	9.1	
61.6	9.2	Wh
64.8	9.4	M
67.6	9.7	Hu

004047
U Cassiop.

1817.3	12.7	Pe
39.7	11.2	B
55.6	9.7	
59.6	10.7	M
61.6	9.6	B
61.6	10.6	
64.5	10.0	Y

004435
V Androm.

1807.5	11.1	Lt
17.4	10.4	
47.6	9.1	B
66.6	9.4	Hu

Sept. 0 = 2421837

004533
RR Androm.

J.D.	Est.	Obs.
242		
1779.5	8.4	Lt
1807.5	9.7	
17.4	10.7	
40.7	11.0	B
66.6	12.9	Hu

004746a
RV Cassiop.

1844.6	12.4	B

004958
W Cassiop.

1800.4	9.8	Lt
07.5	9.7	
19.4	9.7	
40.7	8.8	B
58.6	8.5	
61.6	8.7	Wh
66.6	9.0	M

010102
Z Ceti

1811.9	12.3	δ
17.8	11.7	

010940
U Androm.

1847.6	10.5	B
66.6	10.9	Hu

011272
S Cassiop.

1767.4	9.2	Lt
73.4	9.3	
79.5	8.9	
87.5	8.7	
1805.4	8.7	
19.4	8.9	
43.6	8.9	B
46.8	9.0	M
47.7	9.2	Pt
61.6	9.2	Wh
61.7	8.5	B

012350
RZ Persei

1779.5	10.3	Lt
1844.6	13.5	B
64.5	12.2	Y
64.6	13.2	B

012502
R Piscium

1806.5	10.3	Lt
19.5	9.4	
46.8	8.9	M
64.6	9.1	Pt

Oct. 0 = 2421867

013338
Y Androm.

J.D.	Est.	Obs.
242		
1840.7	13.4	B
64.6	11.0	
66.6	10.9	Hu

014958
X Cassiop.

1779.5	12.7	Lt
1807.4	12.4	
44.6	10.5	B
46.8	11.5	M
61.7	10.4	B

015354
U Persei

1769.5	8.7	Lt
75.5	8.5	
97.4	8.2	
1806.5	8.2	
17.5	8.3	
46.8	8.4	M
47.6	8.5	B

015912
S Arietis

1843.7	11.7	B
64.6	12.5	
64.6	11.4	M

021024
R Arietis

1807.5	11.5	Lt
16.4	10.8	
17.4	10.2	Pe
19 5	10.9	Lt
37.4	8.7	Pe
44.7	11.0	B
47.7	9.5	Pt
50.8	9.0	M
64.6	11.6	B

021143
W Androm.

1769.5	8.4	Lt
79.5	8.8	
93.4	9.2	
1806.5	9.5	
17.5	9.9	
50.8	10.0	M

021281
Z Cephei

1779.5	11.9	Lt
1807.5	12.4	
19.5	13.0	
42.6	13.8	B

021403
o Ceti

1791.8	7.6	δ
94.6	6.9	Lt
1800.6	6.6	

o Ceti

J.D.	Est.	Obs.
242		
06.5	6.3	Lt
07.5	6.1	Vo
09.5	6.1	Lt
11.8	5.7	δ
12,7	5.5	
14.5	5.4	Pe
16.6	5.1	
17.5	6.1	Lt
17.5	5.1	Pe
17.7	5.2	δ
18.5	5.1	Pe
19.5	5.5	Lt
20.5	5.0	Pe
21.6	5.0	
24.6	5.0	
25.6	4.9	
36.4	4.0	
37.4	4.0	
41.8	3.9	Pt
49.8	3.5	M
50.8	3.8	Pt
54.8	3.5	
63.6	3.7	
63.8	3.4	M
64.8	3.7	Pt
66.6	3.7	Me
67.7	3.7	Pt

021558
S Persei

1847.8	9.2	M
66.6	8.8	B

022000
R Ceti

1817.8	12.2	δ

022150
RR Persei

1866.6	3.1	Ba

022813
U Ceti

1812.7	11.8	δ
17.8	12.1	

023133
R Trianguli

1769.5	7.7	Lt
75.5	7.8	
93.4	8.5	
1806.4	9.0	
43.8	10.5	M
66.6	11.2	B

024217
T Arietis

1806.5	9.7	Lt
19.5	9.7	

VARIABLE STAR OBSERVATIONS, Sept.-Oct., 1918—Continued

024356
W Persei
J.D. Est. Obs.
242
1843.8 10.8 M
47.6 10.4 B

025751
T Horologii
1790.8 11.0 δ
1811.8 11.9
16.7 12.0

031401
X Ceti
1849.8 9.3 M

032043
Y Persei
1843.8 10.0 M
66.6 9.7 B

032335
R Persei
1793.5 12.2 Lt
1806.5 10.8
17.5 9.5
19.4 9.4
40.7 9.0 B
47.8 9.2 M

033362
U Camelop.
1779.5 7.9 Lt
1800.4 7.8
06.5 7.7
17.4 7.4
63.8 8.0 M

034124
S Fornacis
1790.8 8.9 δ
1811.8 8.9
17.7 8.7

034625
U Eridani
1790.8 13.0 δ
1811.8 13.6
17.7 13.8

035124
T Eridani
1790.8 12.0 δ
1811.8 11.8
17.7 11.9

035916
V Eridani
1864.8 8.8 M

040725
W Eridani
1811.8 12.6 δ
17.8 12.7

041619
T Tauri
1846.8 9.4 M

042215
W Tauri
J.D. Est.Obs.
242
1846.8 11.4 M
63.8 12.2

042309
S Tauri
1866.7 13.6 B

043065
T Camelop.
1779.5 8.5 Lt
1806.5 9.4
19.5 9.7
49.7 11.3 M

043208
RX Tauri
1863.8 11.0 M

043263
R Reticuli
1811.8 12.5 δ
17.8 13.0

043274
X Camelop.
1767.4 9.6 Lt
73.4 9.1
87.5 8.2
93.4 8.2
1806.4 8.1
17.5 8.3
49.8 11.2 M
64.5 12.5 Y

043562
R Doradus
1790.8 5.6 δ
1811.8 5.3
17.8 5.4

043738
R Caeli
1811.8 11.8 δ
17.8 11.7

044349
R Pictoris
1811.8 7.6 δ
17.8 7.3

044617
V Tauri
1863.8 10.1 M

045514
R Leporis
1811.9 8.5 δ
17.8 8.6

050022
T Leporis
1811.9 13.0 δ
17.8 12.9

050953
R Aurigae
J.D. Est.Obs.
242
1806.5 12.2 Lt
19.5 12.1
46.8 10.2 M
66.7 9.3 B

051247
T Pictoris
1811.8 8.6 δ
17.8 7.9

051533
T Columbae
1811.8 10.6 δ
17.8 10.3

052034
S Aurigae
1849.8 9.5 M
64.7 9.3 B

052036
W Aurigae
1849.8 10.6 M
64.7 10.8 B

053068
S Camelop.
1779.5 8.8 Lt
87.5 8.7
1806.5 8.8
19.5 8.8
49.8 10.1 M

053531
U Aurigae
1864.7 9.1 B
64.8 10.8 M

054319
SU Tauri
1864.8 9.4 M

054974
V Camelop.
1864.5 11.7 Y
66.6 11.7 Wh

054920
U Orionis
1846.8 7.8 M
54.9 7.6 Pt
64.8 8.4 M
67.8 8.6 Pt

055353
Z Aurigae
1809.4 9.8 Lt
46.8 9.5 M

055686
R Octantis
J.D. Est.Obs.
242
1785.7 10.1 δ
1802.5 10.5
08.7 10.6
12.5 10.9
16.7 10.8

060450
X Aurigae
1809.4 9.8 Lt
46.8 8.8 M

060547
SS Aurigae
1846.8 11.4 M
66.7 9.3 B

061647
V Aurigae
1864.8 9.1 M
66.7 8.8 B

061712
V Monoc.
1811.9 11.1 δ
17.8 11.1
64.9 8.0 M

063159
U Lyncis
1860.5 13.0 Y

063558
S Lyncis
1775.5 10.5 Lt

064707
W Monoc.
1811.9 10.8 δ
17.8 10.8

065208
X Monoc.
1811.9 9.4 δ
17.8 9.4
64.9 8.1 M

065355
R Lyncis
1775.5 9.7 Lt
79.5 9.9
1819.5 11.6

071044
L^2 Puppis
1811.8 5.5 δ
17.8 5.0

072106
Nova Monoc.
1817.8 11.1 δ

072708
S Can. Min.
1864.9 7.3 M
67.7 7.0 Pt

074323
T Gemin.
J.D. Est.Obs.
242
1864.8 10.3 M

074922
U Gemin.
1864.8 10 9 M

080322
RU Puppis
1817.9 7.4 δ

091868
RW Carinae
1801.5 10.5 δ
08.7 10.4
11.5 10.8
16.6 11.1
17.9 11.6

092962
R Carinae
1801.5 9.8 δ
04.5 9.5
11.5 9.7
12.5 9.7
17.5 9.5

094023
RR Hydrae
1802.4 13.5 δ

094262
l Carinae
1801.5 3.6 δ
02.4 3.9
11.4 4.7
12.4 4.7
17.4 4.5

094622
Y Hydrae
1801.5 7.0 δ
11.5 6.5

100537
R Antliae
1801.5 7.4 δ
04.5 7.5
11.5 7.3
17.5 7.6

100661
S Carinae
1801.5 6.6 δ
04.5 6.6
11.5 7.0
14.6 7.2
16.6 7.3

103212
U Hydrae
1801.5 5.3 δ
11.5 5.4

VARIABLE STAR OBSERVATIONS, Sept.-Oct., 1918—Continued.

103769
R Urs. Maj.

J.D. 242	Est.	Obs.
1769.4	7.5	Lt
75.4	7.7	
87.5	8.1	
1806.4	8.8	
17.4	9.2	
24.3	9.9	Pe
42.6	10.2	B
58.5	11.1	
59.6	11.6	M

104620
V Hydrae

1801.5	7.0	δ
11.5	6.5	
12.4	6.7	

114441
X Centauri

1801.5	10.6	δ
11.5	9.9	
17.5	9.5	

115919
R Comae

1775.4	8.4	Lt

121418
R Corvi

1811.5	11.7	δ

122532
T Can. Ven.

1782.4	12.8	Lt
1807.4	10.4	
19.4	10.2	

123160
T Urs. Maj.

1769.4	8.5	Lt
73.5	8.4	
82.4	8.4	
87.5	8.4	
93.5	8.5	
1805.4	9.0	
13.3	9.1	Pe
17.3	9.1	
17.4	9.3	Lt
19.3	9.3	Pe
24.3	9.5	
36.3	10.1	
42.6	10.2	B
58.6	11.2	
59.6	11.2	M
65.6	11.3	Y

123307
R Virginis

1775.4	7.6	Lt

123459
RS Urs. Maj.

J.D. 242	Est.	Obs.
1842.6	12.5	B
58.6	10.2	
59.6	9.9	M

123961
S Urs. Maj.

1769.4	8.6	Lt
73.5	8.4	
82.4	8.4	
87.5	8.3	
94.5	8.2	
1805.4	8.2	
13.3	8.7	Pe
17.4	8.5	Lt
19.3	8.5	Pe
24.3	8.7	
36.3	9.8	
42.6	9.4	B
58.5	9.5	
59.5	11.1	M

124025
Y Can. Ven.

1775.4	5.2	Lt
82.4	5.3	
1806.4	5.4	
19.4	5.2	

124606
U Virginis

1775.4	8.8	Lt

131283
U Octantis

1802.5	12.4	δ
08.7	11.8	
12.6	11.6	
16.7	11.5	

131546
V Can. Ven.

1769.4	8.5	Lt
75.4	8.7	
93.4	8.2	
1806.5	7.6	
17.4	7.1	

132422
R Hydrae

1802.5	5.5	δ
12 5	5.3	
17.6	5.2	

133273
T Urs. Min.

1775.5	11.9	Lt
1807.5	13.2	

133633
T Centauri

J.D. 242	Est.	Obs.
1801.5	6.2	δ
02.5	6.1	
04.5	6.1	
08.6	6.2	
12.5	6.1	
14.6	6.3	
16.6	6.5	

134236
RT Centauri

1802.4	12.8	δ
08.6	13.1	
16.6	13.2	

134440
R Can. Ven.

1775.5	9.9	Lt
1805.4	9.5	
19.4	8.8	
42.6	7.6	B
46.6	8.0	Pt
66.5	8.0	M

134677
T Apodis

1787.5	8.8	δ
1802.5	9.0	
08.6	9.0	
14.6	9.5	
16.6	9.6	

140113
Z Bootis

1775.5	12.2	Lt

140528
RU Hydrae

1802.4	13.9	δ
14.6	13.6	
16.6	13.5	

140959
R Centauri

1790.8	8.3	δ
1802.5	7.6	
08.6	7.4	
11.5	7.6	
12.6	7.5	
14.6	7.5	
16.6	7.4	

141567
U Urs. Min.

1779.5	9.8	Lt
1806.5	9.0	
19.4	8.3	
42.6	7.7	B

141954
S Bootis

J.D. 242	Est.	Obs
1794.5	12.5	Lt
1806.4	11.8	
16.4	11.5	
51.6	9.4	B
64.6	9.1	Wh

142205
RS Virginis

1779.4	8.3	Lt

142584
R Camelop.

1769.4	9.8	Lt
73.4	9.6	
82.4	9.5	
87.5	9.4	
97.4	9.2	
1805.5	9.1	
17.5	8.7	
42.6	8.0	B

142539
V Bootis

1769.4	9.7	Lt
79.4	9.3	
94.4	8.6	
1806.4	7.7	
17.3	10.4	Pe
17.4	7.7	Lt
20.3	10.4	Pe
24.3	10.4	
38.6	7.3	Pt
40.6	7.4	B
56.6	7.2	
66.5	7.9	M

143227
R Bootis

1769.4	10.4	Lt
79.4	11.1	
94.4	11.7	
1806.4	12.0	
07.5	12.0	
17.4	12.0	
36.6	12.5	B
37.3	11.1	Pe

144918
U Bootis

1779.4	12.1	Lt
1807.4	11.3	
40.6	10.3	B
66.5	10.8	M

145254
Y Lupi

1790.7	12.8	δ
1802.5	10.8	
04.5	10.7	
08.6	10.1	
14.6	9.2	
16.6	9.2	

151714
S Serpentis

J.D. 242	Est.	Obs.
1775.4	10.5	Lt
83.4	10.0	
1806.4	8.6	
19.4	8.2	
66.5	9.9	M

151731
S Coronae

1779.5	11.5	Lt
1806.4	12.4	
19.4	12.4	

151822
RS Librae

1787.5	10.7	δ
1802.5	10.4	
04.5	10.4	

152849
R Normae

1790.7	8.1	δ
1802.5	7.9	
08.6	7.8	
14.6	7.8	
16.6	8.0	

153378
S Urs. Min.

1782.4	11.9	Lt
1806.5	11.3	
17.5	11.2	
66.5	9.8	B

153654
T Normae

1790.7	6.7	δ
1802.5	6.8	
08.6	7.3	
14.6	7.4	
16.6	7.4	

154428
R Coronae

1750.4	7.6	Vo
53.4	7.7	
67.4	7.4	Lt
73.5	7.4	
75.4	7.3	
81.4	7.1	
91.4	6.8	
97.4	6.9	
1806.4	7.0	
13.3	6.8	Pe
17.3	6.8	
17.4	7.0	Lt
19.3	6.8	Pe
33.3	6.8	
36.3	6.8	
37.7	6.4	Go
38.6	6.4	Pt

VARIABLE STAR OBSERVATIONS, Sept.-Oct., 1918—Continued.

R Coronae

J.D. 242	Est.	Obs.
1840.6	6.4	Pt
42.7	6.5	
42.8	7.0	Mu
43.6	6.5	Pt
44.7	6.2	
45.6	6.6	
45.6	6.4	M
46.6	6.3	Pt
47.6	6.5	
50.6	6.3	
55.6	6.3	
59.6	6.1	
60.6	6.3	
61.6	6.3	
61.6	6.4	Wh
63.6	6.0	Pt
63.7	6.9	Mu
64.6	6.2	Pt
64.7	7.0	Mu
65.8	6.7	Go
66.5	6.3	M
66.6	6.8	Re
66.7	7.0	Mu

154536
X Coronae

1775.4	9.6	Lt
1805.4	10.5	
19.4	11.4	
61.5	13.3	B

154639
V Coronae

1779.4	10.8	Lt
1806.5	10.6	
19.4	10.2	
45.6	9.2	M

154615
R Serpentis

1779.5	10.1	Lt
1806.4	11.0	
19.3	11.5	Pe
19.4	11.9	Lt
40.6	13.0	B

154736
R Lupi

1790.7	10.7	δ
1802.5	11.6	
06.5	18.4	
08.6	11.7	
14.6	12.1	
16.6	12.0	

155947
X Herculis

1770.4	7.2	Lt
81.4	6.6	
87.4	6.4	

X Herculis

J.D. 242	Est.	Obs.
1808.4	6.5	Lt
17.4	6.5	
17.4	6.3	Pe
42.8	6.1	Mu
62.8	6.2	
64.7	6.1	
66.7	6.1	

160118
R Herculis

1839.6	12.8	B
61.6	9.7	
66.6	9.7	M

160210
U Serpentis

1779.5	12.5	Lt
1806.4	11.4	
19.4	10.9	
65.6	8.6	Y
66.5	7.9	B
66.5	8.8	M

160325
SX Herculis

1773.5	7.9	Lt
82.4	8.2	
1800.4	8.7	
05.4	8.7	
20.4	8.6	

160625
RU Herculis

1839.6	14.0	B

*161122*b
S Scorpii

1769.4	9.6	Lt

161138
W Coronae

1775.4	9.9	Lt
1805.4	9.2	
19.4	9.5	
40.6	9.9	B
54.6	11.1	
64.6	11.2	Wh
64.6	11.0	Y
66.6	11.5	M

161607
W Ophiuchi

1839.6	9.8	B

162119
U Herculis

1769.4	10.8	Lt
73.4	10.6	
87.5	10.4	
1806.4	10.6	

U Herculis

J.D. 242	Est.	Obs.
1817.4	9.1	
17.4	9.1	Pe
33.4	8.8	
36.4	8.5	
56.6	7.3	B
60.6	7.6	Pt
64.6	7.4	Wh
66.5	7.4	M
66.8	7.8	Go

162112
V Ophiuchi

1779.5	8.1	Lt
1812.4	8.2	
39.6	7.5	B

162319
Y Scorpii

1864.5	11.2	Y

162542
g Herculis

1769.4	4.8	Lt
78.4	4.9	
90.4	5.0	
1808.4	5.3	
17.4	5.2	
17.4	4.8	Pe
42.8	4.8	Mu
62.8	5.0	
64.7	4.9	
66.7	5.2	

162807
SS Herculis

1769.5	11.6	Lt
73.4	11.4	
79.4	10.7	
83.4	10.3	
87.4	10.1	
94.5	10.1	
1805.4	10.0	
16.4	10.0	

163172
R Urs. Min.

1779.5	9.5	Lt
1848.6	9.5	B
63.8	10.3	M

163137
W Herculis

1767.4	8.3	Lt
73.4	8.0	
1806.5	8.4	
19.4	8.9	
48.6	10.4	B
64.6	11.3	Y
66.6	11.4	M

163266
R Draconis

J.D. 242	Est.	Obs.
1773.4	11.4	Lt
75.5	11.5	
1806.5	12.6	
19.4	12.8	
40.6	12.8	B
61.6	11.8	
63.8	12.4	M
65.6	11.8	Y

164055
S Draconis

1787.5	9.0	Lt
1813.5	9.1	
42.7	8.9	Pt
65.7	8.7	Wh
66.6	8.6	M

164319
RR Ophiuchi

1839.6	9.0	B

164715
S Herculis

1767.4	9.9	Lt
73.5	9.7	
87.5	9.4	
1806.4	9.2	
17.4	8.9	
42.7	8.2	B
63.6	7.8	Pt
64.6	8.0	Wh
66.6	7.8	M

164844
RS Scorpii

1790.7	10.3	δ
1802.6	10.7	
08.6	10.7	
12.6	10.9	
14.6	11.1	
16.6	10.8	

165030
RR Scorpii

1790.7	9.2	δ
1802.6	10.9	
08.6	10.1	
11.6	10.1	
16.6	10.2	
19.5	10.3	

165631
RV Herculis

1773.4	10.7	Lt
83.4	11.9	
1806.4	13.2	
66.6	11.6	M

170215
R Ophiuchi

J.D. 242	Est.	Obs.
1819.4	9.4	Pe
20.3	9.4	
46.6	8.2	Pt
60.6	8.0	

170627
RT Herculis

1839.6	12.6	B
61.6	10.0	

171401
Z Ophiuchi

1767.4	9.5	Lt
73.5	9.6	
94.5	10.1	
1805.4	10.4	
17.4	11.0	
36.6	11.5	B
47.6	11.6	

171723
RS Herculis

1769.5	12.5	Lt
75.4	12.3	
87.5	11.6	
1800.4	10.5	
06.4	10.0	
17.4	9.4	
20.4	9.0	Pe
56.6	7.9	B
64.6	8.0	Wh
66.6	8.4	Re
66.6	8.2	M

172486
S Octantis

1787.5	11.0	δ
1802.5	9.2	
08.7	8.4	
12.5	7.6	
16.7	7.6	

172808
RU Ophiuchi

1840.6	10.5	B
56.6	11.7	
66.6	10.2	M

173457
TY Draconis

1733.4	9.3	Pe

175111
RT Ophiuchi

1779.5	10.0	Lt
87.5	10.4	
1806.4	11.0	
42.6	11.8	B

175458
T Draconis

1851.6	11.0	B
59.6	12.0	M

VARIABLE STAR OBSERVATIONS, Sept.-Oct., 1918—Continued.

175519
RY Herculis

J.D. 242	Est.	Obs.
1773.4	9.3	Lt
1806.4	11.5	
13.4	13.0	Pe
19.5	12.9	Lt
20.4	13.1	Pe
46.7	13.8	B

175654
V Draconis

1866.6	8.4	M

180363
R Pavonis

1790.7	8.5	δ
1802.6	8.9	
08.7	9.5	
12.6	9.9	
14.6	10.0	
16.6	9.9	

180531
T Herculis

1769.5	11.8	Lt
73.4	12.3	
75.4	12.5	
1805.4	13.2	
17.4	13.2	
17.4	12.2	Pe
33.3	11.3	
36.3	11.2	
56.6	9.5	B
60.6	9.2	Pt
64.6	9.1	Wh
66.6	8.8	M
66.8	8.6	Go

180565
W Draconis

1840.6	12.6	B
61.6	11.0	
65.7	10.2	Wh
66.6	9.9	M

181031
TV Herculis

1813.4	9.7	Pe
17.4	9.5	
19.4	9.5	
20.4	9.4	
33.3	9.7	
36.3	10.2	

181103
RY Ophiuchi

1775.5	11.0	Lt
87.4	12.7	
1806.4	12.6	
19.4	12.7	
40.6	12.4	B
61.6	9.1	

181136
W Lyrae

J.D. 242	Est.	Obs.
1769.4	11.4	Lt
73.5	11.7	
75.4	12.1	
79.5	12.3	
1805.4	12.1	
17.4	10.9	
51.6	8.7	B
64.6	8.2	Y
64.7	8.4	M
65.6	8.6	Wh

182133
RV Sagittarii

1790.7	12.4	δ
1802.6	12.9	
08.6	13.0	
12.6	13.4	
14.6	13.5	
16.6	13.5	

182224
SV Herculis

1773.4	9.8	Lt
1805.4	11.2	
19.4	11.6	
46.7	13.3	B

182306
T Serpentis

1775.5	11.6	Lt
87.5	11.9	

183225
RZ Herculis

1773.4	10.6	Lt
1800.4	10.7	
05.4	10.8	
19.4	11.6	
64.6	12.6	Y

183308
X Ophiuchi

1769.5	7.1	Lt
79.4	6.9	
87.5	6.8	
94.5	6.8	
1806.4	6.6	
17.4	6.9	
42.6	7.6	B
58.6	7.9	
65.5	7.9	Wh

184205
R Scuti

1750.4	5.5	Vo
51.4	5.6	
53.4	5.6	
56.4	5.5	
71.4	6.6	Lt
73.4	7.0	Vo
79.4	7.2	Lt

R Scuti

J.D. 242	Est.	Obs.
1779.4	7.1	Vo
86.5	7.4	
88.4	7.4	
88.5	7.7	δ
90.8	7.7	
91.4	7.4	Lt
93.4	7.6	Vo
99.4	7.3	Lt
99.4	7.2	Vo
1800.4	7.2	
01.4	7.1	
02.6	6.7	δ
04.3	6.4	
05.6	6.6	Vo
06.4	6.7	
07.4	6.7	Lt
07.4	6.5	Vo
08.7	6.8	δ
09.2	6.4	
10.3	6.8	Pe
12.6	6.5	δ
13.3	6.5	Pe
14.6	6.2	δ
16.4	6.1	Lt
16.6	6.2	δ
17.3	6.4	Pe
18.3	6.3	
20.3	6.1	
26.3	5.8	
31.3	5.8	
32.3	5.8	
37.3	5.6	
37.7	5.3	Go
38.6	5.4	Pt
40.6	5.3	
42.6	5.1	
42.8	5.7	Mu
43.6	5.0	Pt
44.7	5.2	
45.6	4.8	M
45.7	5.2	Pt
46.6	5.4	
47.6	5.5	
49.6	5.4	
50.6	5.4	
55.6	5.7	
58.7	5.4	
59.6	5.5	
60.6	5.5	
61.6	5.4	Wh
61.6	5.4	Pt
62.8	5.1	Mu
63.6	5.4	Pt
63.7	5.0	Mu
64.6	5.1	Hu
64.6	5.6	Pt
64.7	5.1	Mu
65.8	5.4	Go

R Scuti

J.D. 242	Est.	Obs.
1866.7	5.8	Re
66.7	5.6	Mu
67.6	5.7	Pt

184243
RW Lyrae

1847.7	12.4	B

184300
Nova Aquilae

1753.4	1.2	Vo
53.7	0.6	Go
56.3	0.6	Vo
57.3	0.9	
57.6	0.5	Go
58.3	1.1	Vo
58.4	0.5	Fl
58.6	0.9	Go
59.4	1.2	Gi
59.7	1.2	Go
60.4	1.8	Fl
60.4	1.6	Vo
60.6	1.4	Go
61.3	1.8	Gi
61.3	1.8	Vo
61.4	1.9	Fl
63.3	2.4	Vo
63.4	2.2	Fl
63.7	2.0	Go
64.3	2.4	Vo
64.4	2.2	Gi
64.7	2.2	Go
65.6	2.3	
66.3	2.6	Gi
67.3	2.9	Vo
68.3	2.9	
68.4	2.9	Gi
69.7	2.6	Go
70.3	3.0	Gi
71.3	3.3	
71.4	3.5	Vo
71.6	3.2	Go
72.3	3.9	Gi
72.7	3.9	Go
73.4	4.0	Gi
73.4	3.9	Vo
74.4	3.9	Gi
75.4	3.4	Vo
76.8	3.4	Go
77.3	3.4	Gi
77.8	3.4	Go
78.4	3.1	Gi
79.3	3.1	
79.4	3.0	Vo
79.8	3.4	Go
81.4	3.3	Gi
81.4	3.3	Vo
82.3	3.4	Gi
82.4	3.5	Vo
82.8	3.3	Go

Nova Aquilae

J.D. 242	Est.	Obs.
1783.3	3.5	Gi
85.3	3.7	
86.5	3.9	Vo
87.3	4.1	Gi
87.6	3.8	δ
88.4	3.8	Vo
88.4	3.9	Gi
88.5	3.6	δ
88.8	3.5	Go
89.3	3.9	Gi
90.3	3.7	
90.4	3.8	Lt
90.4	3.7	Vo
90.8	3.8	δ
91.3	3.9	Vo
91.4	3.5	Lt
91.7	3.7	δ
92.3	3.9	Vo
92.3	3.9	Gi
93.3	3.9	Vo
93.4	3.9	Gi
93.4	3.8	Lt
94.3	4.0	Gi
94.4	3.9	Lt
94.4	3.8	Vo
95.4	4.1	Lt
95.4	4.1	Vo
96.3	4.6	
96.4	4.6	Gi
96.4	4.3	Lt
96.4	4.4	Fl
96.8	3.7	Go
97.3	4.6	Gi
97.4	4.5	Lt
97.4	4.3	Fl
98.3	4.4	Gi
99.3	4.3	Vo
99.3	4.1	Gi
99.4	3.8	Fl
99.4	4.3	Lt
1800.3	4.0	Vo
00.3	4.0	Gi
00.4	3.7	Fl
00.4	3.9	Lt
01.3	3.9	Vo
01.4	3.9	Gi
01.4	3.8	Lt
01.6	3.7	δ
02.6	3.8	
03.3	3.9	Gi
03.5	3.9	δ
04.3	3.8	
04.4	4.0	Gi
04.5	3.8	Lt
05.3	4.1	Gi
05.5	4.0	Lt
05.6	3.8	δ
06.4	4.1	Gi
06.4	3.9	Fl

VARIABLE STAR OBSERVATIONS, Sept.-Oct., 1918—Continued.

Nova Aquilae			Nova Aquilae			Nova Aquilae			191019 R Sagittarii			193509 RV Aquilae		
J.D. 242	Est.	Obs.	J.D. 242	Est.	Obs.	J.D. 242	Est.	Obs.	J.D. 242	Est.	Obs.	J.D. 242	Est.	Obs.
1806.4	4.2	Vo	1824.3	4.3	Pe	1850.6	4.9	Pt	1791.8	11.1	δ	1862.6	9.4	Wh
06.4	3.9	Lt	26.3	4.9	Gi	50.7	4.8	J	1840.6	8.3	B			
07.3	4.2	Pe	26.3	4.3	Pe	51.6	4.8		64.6	6.9	Pt	193732 TT Cygni		
07.3	4.6	Gi	27.3	4.9	Gi	52.6	4.9					1845.6	7.9	Pt
07.4	4.5	Fl	27.3	4.7	Pe	55.5	4.9		191033 RY Sagittarii			50.8	8.7	M
07.4	4.7	Lt	28.3	4.9	Gi	55.6	4.9	B	1787.6	6.7	δ	64.6	7.6	Hu
07.5	4.8	Vo	29.3	4.6	Pe	56.5	4.9	Y	90.7	7.1		66.6	7.6	B
08.6	4.2	δ	31.3	4.5		56.6	4.9	J	1801.5	7.1				
08.8	4.0	Go	32.3	4.4		58.6	4.9	B	03.5	7.1		193972 T Pavonis		
09.4	4.7	Fl	33.3	4.4		58.7	4.9	Pt	05.7	7.1		1790.7	12.6	δ
09.4	4.8	Lt	36.3	4.6		59.5	4.8	J	08.7	7.0		1803.6	11.6	
09.4	4.9	Vo	36.6	4.6	B	59.5	4.8	Fr	12.5	7.0		08.7	10.9	
10.3	4.3	Pe	37.3	4.7	Pe	59.6	5.1	Wh	14.6	7.1		12.7	10.0	
10.3	4.9	Gi	38.6	4.6	J	59.6	4.8	Re	16.6	7.0		14.6	10.1	
10.3	4.7	Vo	38.6	4.8	Wh	56.6	4.9	Pt	17.8	7.0		16.6	9.5	
10.4	4.5	Fl	38.6	4.9	B	60.5	4.9	Fr	19.5	6.7				
10.4	4.7	Lt	38.6	5.1	Me	60.5	4.8	Y				194048 RT Cygni		
11.3	4.9	Gi	38.6	4.8	Fr	60.6	5.0	Pt				1773.5	7.3	Lt
11.5	4.3	δ	38.6	4.8	Re	61.5	4.9	B	191124 TY Sagittarii			93.5	8.3	
12.3	4.7	Gi	38.6	4.7	Pt	61.6	5.3	Wh	1790.7	11.3	δ	1805.4	9.1	
12.4	4.0	Fl	39.6	4.8	B	61.6	4.8	Re	1803.6	9.7		17.4	10.0	
12.4	4.2	Lt	39.6	4.8	Fr	61.6	4.9	Pt	05.6	9.7		59.6	12.3	M
12.6	4.1	δ	39.6	4.8	Re	62.8	4.8	Mu	08.7	9.5		64.6	12.0	B
13.3	3.8	Pe	39.7	4.7	J	63.6	4.8	Pt	12.6	9.2				
13.3	4.0	Gi	40.6	4.6	Y	63.6	4.8	J	14.6	9.3		194348 TU Cygni		
13.4	4.0	Lt	40.6	4.8	B	64.5	4.9	B	16.6	9.2		1773.5	12.5	Lt
14.3	4.3	Pe	40.6	4.8	Re	64.5	5.0	Y				1859.6	13.2	M
14.3	4.0	Gi	40.6	4.8	Pt	64.6	5.3	Wh				64.7	13.5	B
14.6	4.0	δ	41.6	4.8	Fr	64.6	4.9	J						
15.3	4.1	Gi	42.6	4.8	B	64.6	4.9	Re	192745 AF Cygni			194604 X Aquilae		
15.4	3.9	Fl	42.7	4.5	Y	64.6	4.8	Pt	1744.4	7.3	Vo	1787.5	11.6	Lt
15.4	3.9	Lt	42.7	4.6	Pt	64.7	5.2	Mu	50.4	7.3		1807.5	12.3	
16.3	4.3	Pe	42.8	4.4	Mu	65.5	4.8	Fr	53.4	7.4		36.6	13.5	B
16.3	4.1	Gi	43.5	4.5	Y	65.5	5.0	Y	73.4	7.4	Lt	46.7	13.7	
16.4	4.1	Fl	4.36	4.8	Wh	65.6	4.9	B	79.4	7.2				
16.4	4.1	Lt	43.6	4.7	B	66.5	4.9	J	79.4	7.3	Vo	194659 S Pavonis		
16.6	4.1	δ	43.6	4.6	Re	66.5	4.8	Fr	88.4	6.8		1790.7	7.3	δ
17.3	4.4	Gi	43.6	4.5	Pt	66.6	4.9	B	97.4	7.1	Lt	1805.6	6.8	
17.4	4.1	Fl	44.6	4.8	B	66.6	5.2	Me	1801.4	6.7	Vo	08.7	6.5	
17.3	4.2	Pe	44.6	4.7	Fr	66.6	4.9	Re	06.4	7.1	Lt	12.7	6.6	
17.4	4.2	Lt	44.7	4.6	Pt	66.7	5.6	Mu	17.5	7.5		14.6	6.8	
18.3	4.2	Pe	45.6	4.7		67.6	4.9	Re				16.6	7.0	
18.3	4.7	Gi	45.6	4.8	M	67.6	4.9	Pt						
18.4	4.3	Fl	46.6	4.6	Pt				192928 TY Cygni			194632 χ Cygni		
18.4	4.2	Lt	46.6	4.8	Re	190108 R Aquilae			1859.6	13.5	M			
19.4	4.9	Gi	46.6	4.8	B	1775.5	8.4	Lt				193449 R Cygni		
19.4	4.5	Fl	46.7	4.7	J	1805.4	9.2					1744.	7.3	Vo
19.4	4.8	Lt	47.6	4.8	Re	19.5	9.6					73.5	8.4	Lt
20.3	4.4	Pe	47.6	4.8	Pt	44.6	10.0	B				75.5	8.4	
20.3	4.8	Gi	47.6	4.9	B							87.5	9.1	
20.4	4.3	Fl	47.6	4.9	Fr							93.5	9.5	
20.4	4.6	Lt	47.6	4.8	Re							1805.4	10.3	
21.3	4.5	Pe	47.7	4.5	J	190926 X Lyrae						13.3	10.2	Pe
21.4	5.1	Gi	48.6	4.8	Fr	1864.7	8.9	M				16.4	10.6	Lt
21.4	4.6	Fl	48.6	4.7	Re							50.8	12.0	M
21.4	4.8	Lt	49.6	4.9	Fr							65.7	12.2	Wh
22.3	4.4	Pe	49.6	4.8	Pt	191017 T Sagittarii						66.6	12.0	B
23.3	4.4	Gi	50.6	4.9	Fr	1791.8	12.1	δ						
23.3	4.4	Pe	50.6	4.8	Re									

VARIABLE STAR OBSERVATIONS Sept.-Oct., 1918—Continued.

194929
RR Sagittarii

J.D. 242	Est.	Obs.
1788.5	6.7	δ
90.8	6.7	
1803.6	7.5	
08.7	7.8	
12.6	7.9	
14.6	7.9	
16.6	8.0	

195116
S Sagittae

1842.8	5.3	Mu
62.8	5.2	
63.7	5.5	
64.7	5.6	
66.7	5.8	

195849
Z Cygni

1807.4	12.7	Lt
19.5	12.4	
50.8	11.7	M
66.6	10.2	B

200212
SY Aquilae

1839.6	13.0	B

200357
S Cygni

1793.5	12.2	Lt
1807.4	11.6	
17.4	11.2	
46.8	10.5	M
66.6	10.4	B

200514
R Capricorni

1787.5	11.1	Lt
1806.5	11.3	
99.4	11.4	

200647
SV Cygni

1846.7	9.0	M
60.8	8.5	
66.6	8.3	Hu
66.6	8.1	B

200715a
S Aquilae

1773.5	10.9	Lt
82.4	11.1	
1806.4	10.4	
16.4	10.3	
42.7	9.3	B
45.6	9.4	M
66.6	10.6	

200715b
RW Aquilae

1842.7	9.0	B
45.6	9.3	M
66.6	9.2	

200812
RU Aquilae

J.D. 242	Est.	Obs.
1866.6	9.5	M

200916
R Sagittae

1779.5	9.1	Lt
1806.4	8.8	
42.7	9.2	B
45.6	9.3	M
66.6	9.1	

200938
RS Cygni

1779.6	8.3	Lt
1846.7	8.4	M
63.7	7.5	

200906
Z Aquilae

1775.5	12.1	Lt
87.5	12.7	
1806.4	12.0	
19.4	11.9	
39.6	10.7	B
56.6	9.4	
66.6	9.4	M

201008
R Delphini

1779.5	10.8	Lt
1800.5	9.4	
06.4	9.0	
19.5	9.2	
44.6	8.9	B
45.6	9.8	M
64.6	8.5	Pt

201130
SX Cygni

1779.4	12.9	Lt
1806.4	12.7	
19.5	12.5	
20.4	12.5	
42.6	10.7	B
46.8	11.1	M
65.5	9.0	Y

201121
RT Capricorni

1863.6	8.1	Pt

201139
RT Sagittarii

1790.8	11.6	δ
1803.6	10.8	
08.7	11.1	
12.7	10.6	
14.6	10.4	
16.6	10.8	

201647
U Cygni

J.D. 242	Est.	Obs.
1773.5	7.4	Lt
79.4	7.1	
93.5	7.3	
1806.5	7.2	
17.4	7.3	
45.6	8.2	Pt
46.7	7.5	M
60.8	7.0	

202240
U Microscopii

1790.8	8.9	δ
1805.6	8.6	
08.7	8.5	
12.7	8.7	
14.6	8.6	
16.6	8.7	

202539
RW Cygni

1846.7	8.8	M
60.8	8.6	

202817
Z Delphini

1846.7	13.6	B

202946
SZ Cygni

1860.8	9.6	M
64.6	9.4	Pt
64.6	9.6	Hu
66.7	8.9	B

202954
ST Cygni

1779.4	10.1	Lt
1807.4	10.1	
19.4	10.2	
60.8	10.5	M
65.5	11.7	Y
66.6	12.0	Hu
66.7	12.0	B

203226
V Vulpeculae

1846.8	9.4	M
63.6	9.3	Pt

203611
Y Delphini

1846.7	13.6	B

203816
S Delphini

1783.4	10.7	Lt
1807.5	10.7	
19.4	10.7	
44.6	10.1	B

203847
V Cygni

J.D. 242	Est.	Obs.
1773.5	10.4	Lt
79.4	10.5	
1806.5	11.0	
17.4	11.1	
50.8	11.8	M
66.7	11.1	B

203905
Y Aquarii

1813.4	12.5	Pe
36.3	13.0	

204016
T Delphini

1844.7	14.2	B

204215
U Capricorni

1865.5	11.3	Y

204318
V Delphini

1839.5	11.0	B
56.6	9.2	

204405
T Aquarii

1775.5	7.7	Lt
1805.5	9.1	
13.4	9.4	Pe
19.4	9.7	Lt
32.3	11.0	Pe
36.3	11.6	
43.6	11.4	B

204846
RZ Cygni

1866.6	10.8	M

205030a
UX Cygni

1779.4	11.3	Lt
1807.4	11.5	
63.8	11.9	M

205017
X Delphini

1836.6	9.6	B
56.6	9.3	

205647
RR Capricorni

1803.5	14.8	δ

205923
R Vulpeculae

1767.4	10.0	Lt
73.4	9.1	
82.4	8.7	
93.5	8.7	
1805.4	8.7	
17.4	9.1	
46.8	11.9	M

210129
TW Cygni

J.D. 242	Est.	Obs.
1836.6	13.5	B

210868
T Cephei

1773.5	9.7	Lt
79.4	9.8	
93.5	9.9	
1807.5	9.9	
17.4	9.9	
48.6	8.6	B
60.8	8.6	M
67.6	6.8	Hu

210812
R Equulei

1806.5	10.4	Lt
16.4	10.1	
20.4	10.0	
65.5	13.6	Y

211614
X Pegasi

1779.5	10.2	Lt
87.7	10.5	

212030
S Microscopii

1803.5	14.3	δ

213244
W Cygni

1773.4	6.5	Lt
78.4	6.5	
79.4	6.0	Vo
87.4	6.5	Lt
88.4	6.0	Vo
97.4	6.5	Lt
1801.4	5.9	Vo
07.4	6.7	Lt
15.4	6.8	
32.3	6.5	Pe

213678
S Cephei

1782.4	11.4	Lt
1807.5	11.4	
19.5	11.4	
47.6	9.7	B
60.8	9.6	M
67.6	9.4	Hu

213753
RU Cygni

1779.4	8.7	Lt
1807.4	8.8	
20.4	8.7	
43.8	9.2	M
60.8	9.6	

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213843
SS Cygni

J.D. 242	Est.	Obs.
1767.4	11.8	Lt
72.4	11.8	
79.4	11.9	
91.4	11.8	
99.4	11.8	
1800.4	11.7	
05.4	11.6	
06.4	11.6	
06.5	11.0	
07.4	10.2	
09.4	8.9	
10.4	8.4	
12.4	8.4	
13.4	8.9	Pt
14.3	9.2	
16.4	9.8	Lt
17.4	10.2	
18.3	10.7	Pe
19.4	11.2	Lt
20.3	11.2	Pe
20.4	11.5	Lt
32.3	12.2	Pe
36.3	12.0	
36.6	11.6	B
39.6	11.7	
40.6	11.6	
42.6	9.3	
42.7	9.1	Pt
43.6	8.8	B
43.6	8.6	Pt
43.8	8.4	M
44.6	8.8	B
44.7	8.8	Pt
45.6	8.9	
45.6	8.6	M
46.6	9.0	Pt
46.8	8.8	M
47.6	9.4	B
47.6	9.4	Pt
47.8	9.3	M
48.6	9.5	B
49.8	9.7	M
50.8	10.0	
51.6	10.2	B
51.7	10.3	M
56.6	11.5	B
58.5	11.7	
59.6	11.5	Re
59.6	11.5	M
60.5	11.8	B
61.5	11.6	
63.7	12.0	M
64.5	11.7	B

SS Cygni

J.D. 242	Est.	Obs.
1864.7	12.0	M
65.5	11.9	Y
65.7	12.0	Wh
66.5	11.7	B
66.6	11.0	Hu
66.6	11.6	Re
66.6	11.9	M

213937
RV Cygni

1838.7	7.9	Pt
43.8	8.4	M
53.7	8.0	
66.6	7.5	Hu
67.6	8.1	Pt

214024
RR Pegasi

1782.4	9.8	Lt
87.4	9.5	
1806.5	9.6	
43.6	11.4	B
64.6	12.9	

214247
R Gruis

1790.9	11.2	δ
1805.6	11.9	
08.7	12.1	
12.7	12.2	
14.6	12.4	
16.7	12.3	

214443
WY Cygni

1813.3	11.0	Pe
33.3	11.0	

215605
V Pegasi

1787.4	10.7	Lt
1807.5	9.5	
19.5	9.2	
44.6	8.6	B
61.6	9.4	

220133a
RY Pegasi

1787.4	12.2	Lt
1806.4	12.1	

220133b
RZ Pegasi

1787.5	11.8	Lt
1806.4	12.2	

220412
T Pegasi

J.D. 242	Est.	Obs.
1836.6	12.8	B
46.6	13.3	

220714
RS Pegasi

1836.6	12.5	B
46.6	12.2	

221321
X Aquarii

1791.8	9.0	δ
1812.7	10.5	
17.7	10.5	

221922
RT Aquarii

1791.8	12.2	δ
1812.7	12.5	
17.7	12.5	

221948
S Gruis

1790.8	8.5	δ
1805.6	8.5	
08.7	8.8	
12.7	9.2	
14.6	9.2	
17.6	9.2	

222439
S Lacertae

1779.4	10.6	Lt
1806.5	11.1	
19.4	11.2	
44.6	13.1	B
50.8	12.0	M
64.6	12.1	B

224362
T Tucanae

1790.8	12.7	δ
1805.6	11.4	
08.7	11.0	
12.7	11.1	
14.6	10.9	
17.6	10.8	

223841
R Lacertae

1779.4	10.8	Lt
1806.5	12.0	
50.8	12.3	M

225120
S Aquarii

J.D. 242	Est.	Obs
1791.8	12.5	δ
1812.7	13.9	
17.7	14.0	
66.6	12.6	B

225914
RW Pegasi

1839.7	13.7	B
64.5	13.3	
65.5	12.5	Y

230110
R Pegasi

1779.5	13.0	Lt
87.4	13.0	
1806.4	13.0	
16.4	13.0	
36.3	12.9	Pe
65.5	12.8	Y

230759
V Cassiop.

1779.5	10.9	Lt
82.4	11.1	
1807.5	12.2	
19.4	12.5	
36.3	13.0	Pe
47.6	12.8	B

231508
S Pegasi

1836.3	11.8	Pe
64.5	11.8	B

232246
V Phoenicis

1790.8	9.2	δ
1805.6	9.8	
08.7	9.8	
12.7	10.0	
14.6	10.0	
17.6	10.3	

233335
ST Androm.

1844.6	10.1	B
59.6	11.0	Re
60.8	9.8	M
61.6	10.9	Wh
66.6	10.6	Hu

233451
SV Cassiop.

J.D. 242	Est.	Obs.
1779.5	9.5	Lt
91.8	9.6	δ
1806.5	9.4	Lt
11.8	9.4	δ
17.4	9.5	Pe
17.7	9.4	δ
19.5	9.5	Lt
64.6	8.3	Pt
66.6	7.9	Hu

234716
Z Aquarii

1812.7	9.2	δ
17.7	9.4	

235150
R Phoenicis

1790.8	9.0	δ
1805.6	9.9	
08.7	10.2	
12.7	10.4	
14.6	10.7	
17.6	10.7	

235209
V Ceti

1811.8	13.0	δ
17.7	12.9	

235350
R Cassiop.

1773.5	9.2	Lt
79.5	9.2	
82.4	9.3	
97.4	9.4	
1806.5	9.8	
17.4	9.8	
36.6	12.6	B
47.6	12.8	

235525
Z Pegasi

1866.6	8.5	Wh

235750
W Ceti

1791.8	8.6	δ
1811.8	10.0	
17.8	10.0	

235939
SV Androm.

1864.6	13.3	B

No. of Observers: 1771 No. of Stars Observed: 275 No. of Observers: 15

ANNUAL REPORT OF THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS

RECORD OF OBSERVATIONS

1917	Miss Allen	Bancroft	Benini	Bolfing	Bouton	Bryan	Burbeck	Dawson	Delmhorst	De Perrot	Francis	Gould	Houdard	Hunter	Jacobs	Lacchini	Luyten	McAteer	Meeker	Mundt	Murray	Nolte	Olcott	D. Pickering	Peltier	Reardon	Miss Reed	Vogelenzang	Vrooman	Whitehorn	Miss Young	Additional Observations	Total Observations	Number of stars observed	Number of observers
Nov.		410	25	49	95	12	90	62	81	159			39	39	8	134	712	93		13		6	46	55		10	7	234	19	86	52	64	2602	269	28
Dec.				76	91	9	47	74	50	29			16	42		51	789	146	32	25		6	32	62		23		152	34	92	53	52	1993	263	25
1918																																			
Jan.	2		39	31	66	21		269	66	75				40		91	191	47	50	19		2		23					28	66	39	4	1169	243	20
Feb.					103					34			23	29		94		35	50	18				7					30	19	36	19	497	144	13
Mar.	3	369			143	9				17			51	27				56	20	8				27	2			61	17	42	32		884	255	16
Apr.		236			133					51			88	36		61		144		6			6	81	30			82	26	29	57	1	1067	211	15
May		219	31		55			88		44				27		137	146	63	10	11					18				26	38	33	13	959	255	16
June		156			59			105	11	13				32		44	450	161	5	17					53				46	27	27	1	1207	238	15
July		36			124					73	9			16	5	95		173	3	22			8	19	68				40	49	35	16	791	168	19
Aug.	28	102			108			158		107	10	12		26	10	101	858	180	16	80			26	17	60				39	50	17		2005	289	20
Sept.		133			150		11	119	6	52	8	5			16	129	20	144	12	115	15		26		102	11	19		47	32	10		1167	346	22
Oct.					202			362		124	12	25		18			566	159	3	30					90	20		64		28	38	30	1771	275	15
Total	33	1661	95	156	1329	51	148	1237	214	778	39	42	217	332	39	937	3732	1401	201	364	15	14	144	291	423	64	26	593	352	558	429	200	16112		

ANNUAL RECORD OF THE ASSOCIATION.

Year	Number of Observations	No. of stars Observed	Number of Observers
1912	6180	175	19
1913	12914	200	20
1914	14506	255	28
1915	14724	282	29
1916	11261	290	30
1917	15788	332	43
1918	16112	380	34
	91485		

Reference cards have been sent out to our members for the purpose of keeping a record of personal data concerning our individual members. These cards should be filled out and sent to our historian, Mr. H. R. Schulmaier, Berwick, Me.

The reports must be condensed as much as possible and members are urged not to observe the same star oftener than once or twice a month. In cases where a series of observations are made on consecutive dates, only the ten day mean observations should be included in the list sent to the secretary. In this way we can condense the reports without impairing their scientific value.

The following calculated dates of Maxima and Minima are cited from Mr. Leon Campbell's list:—

Nov.	4	203816	S Delphini	Min.	Nov.	11	123307	R Virginis Max.
	5	*233815*	R Aquarii	Max.		23	094211	R Leonis Min.
	10	123961	S Urs. Maj.	Min.		23	193449	*R* Cygni Max.

Space does not permit of further comment. The Annual record of the individual contributions of observations to the reports accompanies this report. We have broken our record this year in spite of the distracting influences of the war and in every sense the Association can be said to be in a flourishing condition.

The following observers contributed to this report:—Messrs. Bouton, Dawson, De Perrot, Frijlinck, Ginori, Gould, Hunter, McAteer, Meeker, Mundt, Francis, Peltier, Reardon, Vogelenzang, Whitehorn, Miss Young.

WILLIAM TYLER OLCOTT,
Secretary.

Norwich, Conn.
Oct. 9, 1918.

COMMUNICATIONS.

The Earth's Motion.—In POPULAR ASTRONOMY for May, 1918, page 351, the following paragraph appears:

"If our sun is shrinking and diminishing in volume as stated, the fact would be revealed in the shortening of the orbit of the earth, and that of all the other planets, because the least reduction in the volume of the sun, would also be revealed in the loss of impact, or repulsive force of the light emanating from the sun, which, it is said, counteracts the pull of solar gravitation, and thereby holds the earth and other planets in their respective orbits."

This idea is entirely erroneous. In a certain sense the planets may be regarded not as revolving around the sun, but as moving through space in conformity with the law of inertia the fundamental law governing the motion of matter.

Inertia is defined by Newton's first law which, paraphrasing Newton's language, is:

Matter moves in a straight line with a uniform velocity unless acted upon by some external force.

In other words, the rate of motion and its direction in space remain constant unless an external force comes into action.

In the case of the motion of a planet, the external force is the sun's gravitational attraction, which causes the planet to deviate from a straight line sufficiently to describe a closed curve around the sun.

Were the gravitational force between the earth and sun to cease, the earth would continue moving through space as before, but along a line tangent to its former orbit at the point where gravitation ceased. It would be several months before the diminution in the apparent size of the sun's disc, due to the earth's increasing distance, would begin to be noticeable by visual observation.

Disregarding the small effects produced by the attraction of other planets, there are in the orbital motion of any planet two opposing tendencies; the tendency to move along a straight line tangent to the orbit, due to inertia, and the tendency to approach the sun due to gravitation. In the language of geometry, the orbit is the locus of the point or points, where at each successive instant these two tendencies exactly balance each other.

The direction of a planet's motion is at a right angle with the direction of the sun at aphelion and perihelion only. When the planet is at aphelion its orbital velocity has its lowest or minimum value. In consequence, gravitation gains the ascendancy, and the distance between sun and planet begins to decrease. It is now moving at less than a right angle to the sun, so that gravitation is acting in a direction somewhat ahead of, and therefore favorably to, its motion.

Now, due to its inertia, the planet tends to retain at any instant whatever velocity it may have had the preceding instant. But as gravitation acts continuously, the result is that its motion is being constantly added to or accelerated, so that when it reaches perihelion the orbital velocity has its greatest or maximum value.

Perihelion may be defined as the point where the orbital velocity has increased to such a degree that it begins to overcome the gravitational effect and the distance between sun and planet increases. The planet is now moving at more than a right angle with the sun, or away from the latter, and in consequence gravitation is acting in opposition to this movement, so that when it again reaches aphelion it has lost all of the increase of velocity which it gained while moving from aphelion to perihelion, and the same orbit is repeated.

The orbital motion of a planet is somewhat analagous to the motion of a pendulum, the planet in one half of its orbit swinging in toward the sun under the influence of gravitation, and in the other half swinging away from the sun in consequence of the increased velocity thus gained.

CHARLES O'NEILL.

Frankfort, Ky., Oct. 4, 1918.

The Eclipse at Corona, Colorado.—The following is from a letter written to Mr. J. H. Darling by the telegraph operator at Corona, Colorado, elevation 11660 feet:

Was gratified to know you met with success at Fraser. As for myself: the conditions prevailing at Fraser, as noted in your letter, were almost identical to conditions at Corona. I was on top of Windy Point (near the flag pole) just one hour ahead of time and got pelted with hail and snow before eclipse commenced. The sun was obscured during first contact but was able to view the phase between first contact and total for about fifteen minutes. The second contact was missed on account of a small patch of cloud about the size (apparent) of one's hand drifting between us and sun. This obscured the sun for not to exceed twenty seconds, so we were fortunate in seeing almost the entire total phase. The corona was not as clear as it would have been had the sky been perfectly clear. It appeared a little misty to me. The corona extended from sun's limb for a distance about equal to

the diameter of the sun. The chromosphere was fairly distinct, but the prominences were clear in every detail; the most northern one appeared to have "Two Legs" as it were, and showed a downward curvature from the point of intersection outward.

Owing to my vantage point there is a possibility that I had the good fortune to witness something that you people missed at Fraser, and that was the circle of daylight, visible in all directions, at the middle of totality. The entire phenomena was of a "never-to-be-forgotten" character and certainly made an indelible impression on me.

A. L. BRITT.

Aurora of August 15.—The aurora of Thursday August 15, 1918 began to manifest itself at about 10:30 p. m. (summer time) as a pale apple green glow near the northern horizon. At this time the auroral arch was not visible. The size and brilliancy of the light area grew, and by 11.15 p. m. pale streamers of light had begun to shoot forth from the nebulous mass into the zenith, waving and flickering as if swayed by the wind. The height of the cloudlike formation did not exceed 35° of altitude, while the streamers at times extended beyond Polaris. The light pulsated rapidly from one point to another, while the streamers undulated gracefully. At 12:00 Mid. the point of greatest activity seemed to be attained, and a very bright green arch extended from Arcturus through Draco nearly to the zenith. From this point the arch continued on to the eastern horizon, although it was much fainter. Nebulous patches of light extended through Ursa Major, and even as far east as Capella, the streamers meanwhile playing constantly. At one time (12:30 a. m. about) the western half of the arch turned slightly pink.

While this aurora did not manifest such vivid color contrasts, it was, in my opinion, superior to the aurora which took place on March 7 of this year. On the following day, August 16, 1918, I examined the sun for spots, and found three near the center of the disk, two very large, and in between them a smaller one.

LEWIS J. BOSS.

North Scituate, R. I.

GENERAL NOTES.

Dr. Everett I. Yowell and **Dr. Elliott Smith,** assistants at the Cincinnati Observatory, are giving most of their time to instruction in the Students' Army Training Corps at the University of Cincinnati. There are about 1200 enrolled in the S. A. T. C., and the regular staff of instructors were unable to handle the work.

Professor Frederick Slocum has resigned his position as Director of the Van Vleck Observatory to become Professor of Naval Science at Brown University, Providence, R. I.

Return of Eclipse Instruments from Russia.—From the *Publications of the Astronomical Society of the Pacific* for October, 1918, we learn that the Lick Observatory eclipse apparatus, which was stored in the Russian National Ob-

servatory at Poulkovo in 1914, has at last reached America, arriving at Mt. Hamilton on August 21, 1918. Director Campbell says that he found every item present and in good order, save that the chronometer had suffered minor damage from rough handling.

The Amherst College eclipse equipment was included in the same shipment.

The shipment was delayed four months at Vladivostock and nearly three months at Kobe.

Standard Time at Sea.—The following was printed in the journal "Nauticus" for June 8, 1918.

Heretofore a ship at sea has been a law unto itself and there has never been any certainty in establishing the time relations between events noted on different ships and their translation into Greenwich mean time. Great Britain, France and Italy have adopted standard time differing by exact hours from Greenwich mean time for use on the high seas. At a British Admiralty conference held last winter, it was determined to designate as zero that portion of the earth's surface bounded by meridians 7½ deg. east and west of Greenwich, to designate succeeding fifteen-degree intervals westward, plus one, etc., and succeeding fifteen degree intervals eastward, minus one, etc. The last intervals each way are plus and minus twelve, being parts of a fifteen degree interval split by the international date line. Hour-ahead summer time was not approved by the British conference.

Last year the French Minister of Marine established similar standard time for French ships, but carried the numbering eastward around the earth from zero to twenty-three, with hour-ahead summer time.

The divergence between the British and French systems raises an interesting question as to whether the positive numbers should lead to the eastward or to the westward. Numbering positive to the westward, according to the British system, the numerical designations algebraically added to the local time give the Greenwich mean time. Numbering eastward, according to the French system, the numerical designation added to Greenwich mean time gives the local time, except that a day must be deducted for zones west of Greenwich and east of the international date line. On astronomical maps both right ascension and time are numbered eastward.

"Timely" Suggestions.—The following suggestions as to methods of designating the times of astronomical events, in view of the changes made by the Daylight Saving Law are urged by Mr. Samuel W. Balch, Mechanical Engineer, New York. They were printed in "Nauticus" for June 8, 1918.

Consideration of the hour-ahead summer time now in force draws attention to a serious drawback of the so-called "Daylight Saving Law". By simply directing every one in the United States to put his clock one hour ahead, the railroads were relieved of the necessity of altering schedules or scrapping time tables in which mention is made of different kinds of time. But this camouflage appears to have escaped the sharp eyes of some astronomers and various errors have crept into announcements. In Great Britain, where daylight-saving is also in force, there has been established a "summer time" for use on land, and Greenwich mean time continues undisturbed for navigation and astronomical purposes. Hour-ahead time is in force this year in the United States from March 31, 1918, to October 27, 1918. In Canada it is in force from April 14, 1918, to October 31, 1918. In Newfoundland it is in force from May 5, 1918, to October 6, 1918. In Great Britain it is in force from March 24, 1918, to September 29, 1918.

It would seem highly desirable for the different countries to agree on the same days for changing time. In the United States the days are prescribed by statute, and alteration could be made only by moving cumbrous legislative machinery. In Canada the days are designated by the Governor-in-Council, and alteration would not be difficult.

Astronomical events, according to their character, require to be timed in one or the other of two ways. To avoid confusion, those which occur at a given instant, without regard to the point of view on the earth's surface, such as eclipses of the moon, moon's phases, and moons of Jupiter, should be given in Greenwich mean time as heretofore and accompanied by directions for reduction during the summer as follows:

> Between the last Sunday in March and the last Sunday in October, for United States standard eastern time deduct 4 hours; for United States standard central time deduct 5 hours; for United States standard mountain time deduct 6 hours, and for United States standard Pacific time deduct 7 hours. For British summer time add 1 hour.

It is to be noted that names for the several kinds of time are now prescribed by law and they should therefore be used exactly as above given. To reduce the multiplicity of times and avoid confusion, it would seem desirable to discontinue the use of such other times as Washington mean time and "central mean time" with different meanings from the times established by law and with which they might be confused.

Astronomical events, such as the rising and setting of the moon and planets, which are at nearly the same local hours at all places, should be advanced one hour and accompanied by a heading that times given are according to United States Daylight Saving Law at standard time meridians.

The Distribution of the Stars.—In Volume VII of the "Recherches Astronomique de l'Observatoire d' Utrecht" Mr. H. Nort discusses the results of counts of stars on the Harvard Map of the Sky and compares them with similar counts made by other observers, especially H. Henie of the Lunds Observatory. He finds it important that only the central portions of the plates should be used in star counts and that the limiting magnitude of the stars shown on the photograph should be very rigorously determined. The number of stars down to magnitude 11.0 in the whole sky comes out in the vicinity of 1,000,000, with a considerable range of uncertainty. The distribution of the stars with reference to galactic longitude is very irregular, especially in the Milky Way. The greater part of the galactic light is due to stars fainter than $11^m.0$. The galactic circle is found to lie about 1° $38'$ south of the galactic equator, the southern galactic hemisphere appearing to be much richer in stars than the northern. Finally, the shape of the system of stars down to magnitude 11.0 appears to be an ellipsoid with three unequal axes in the ratio of 45: 56: 86, and with its center in galactic longitude 326° and latitude -20°.

Nova Aquilae 3.—On September 30 and October 8 the new star in Aquila was estimated at magnitude 5.0 by H. C. Wilson at Northfield. Since that time the sky has been filled with moonlight or with clouds, so that no recent estimates have been made here.

In the June number of the *Journal of the British Astronomical Association* it is claimed that two English observers, Captain Piper of Fowey and Mr. W. M. Witchell of the Royal Observatory, Greenwich, saw the nova as a bright star on June 7, the former at 12:45 and the latter between 10:30 and 11 G. M. T. In both cases the observers depend upon their memory of the observation, stimulated by reading the accounts of the discovery of the new star. Mr. C. L. Brook, director of the Variable Star Section of the B. A. A. S., concludes that the observations on June 7 must be attributed to mistakes in the date.

U. S. Naval Observatory.—Volume IX, Parts III and IV, just received, contain the results of observations made with the nine-inch transit circle in the years 1908-1911 and 1912-1913 respectively. The observations were made under the direction of Professor F. C. Littell and the reductions under the direction of Professor W. S. Eichelberger and Assistant Astronomer H. R. Morgan.

An appendix to this volume gives the results of the campaign, undertaken in the winter of 1913-14, for determining the difference of longitude between Paris and Washington by means of radio signals. From the exchange of signals between the Eiffel Tower at Paris and the U. S. Naval station at Radio, Virginia, on 68 nights the final result for the longitude difference

Washington-Paris .... $5^h\ 17^m\ 36^s.653 \pm 0^s.0031$.

This combined with the new determination of the longitude between Greenwich and Paris gives

Washington-Greenwich .... $5^h\ 08^m\ 15^s.721 \pm 0^s.014$.

This applies to the center of the clock-room of the new observatory on Georgetown Heights.

The Velocity of Transmission of Radio Signals.—In the discussion of the determination of the difference of longitude between Washington and Paris mentioned above, the double transmission time of the radio signals between the two places was measured on 39 nights. This came out in the weighted mean as

$$0^s.0429 \pm 0^s.0029$$

since the distance from Washington to Paris is 3,840 miles, the transmission time gives a velocity of transmission of 179,000 ± 12,000 miles per second.

It would thus appear that the Hertzian waves, which convey wireless signals, are ether waves having nearly the same velocity as light.

The Royal Observatory of Belgium, at Uccle, near Brussels, is keeping up a certain amount of astronomical work in spite of untoward conditions. The acting director, Professor Paul Stroobant, is giving weekly popular lectures on astronomy, which are said to be well attended. (*Scientific American*, Oct. 19, 1918.)

Airplane Observation of the Eclipse.—If it develops nothing else of novelty, the recent solar eclipse can fairly lay claim to be the first astronomical event to be observed from an airplane. Although the flight and observation made at Fort Sill, Okla., were not undertaken with any serious scientific object in view, it was at least demonstrated that we may eventually look to the aviator for work of value in connection with eclipses. While most of the undertakings of eclipse time call for a solid foundation, which can hardly be looked for even in the plane of the future, the aviator can at least free the astronomer from his complete subjection to clouds and other superficial weather phenomena. We may, therefore, look for more general use of planes in connection with subsequent eclipses. (*Scientific American*, Oct. 19, 1918.)

Observations of Nova Aquilae.—On the evening of June 11, during our staying at Torisima (St. Peter's I.) for the Total Solar Eclipse Expedition, Dr. Y. Ueta and I discovered the New Star in Aquila, as bright as Vega. Since then we continued watching the sky, after returning to Kyoto. Following are the results of our eye estimations up to this day:

1918	G.M.T.	Estimations	Mag	Remarks
June 11	1.8^h	0^m.1 > Vega...	0^m.0	(Y) bluish
13	5.2	Altair 1 Nova 9 α Ophiuchi	1 .02	(K) bluish
14	2.9	Altair 1.4 Nova 8.6 α Ophiuchi	1 .07	(K) yellowish
"	3.2	" 6 " 4 "	1 .15	"
15	2.0	(Very much fainter than Altair)	1 .8	(Y)
"	"	A little brighter than α Cygni	1 .2	(U)
18	2.0	Nova = α Ophiuchi	2 .14	(Y)
19	0.5	α Ophiuchi 5 Nova 5 η Ophiuchi	2 .39	(K) reddish
"	2.0	A little fainter than α Ophiuchi	2 .3	(Y)
21	2.3	α Ophiuchi 6 Nova 4 ζ Aquilae	2 .67	
		Nova 6 β Ophiuchi 4 ζ Aquilae	2 .82	
		α Ophiuchi 7.5 Nova 2.5 β Ophiuchi	2 .74	2.70 (K)
		Nova 5 γ Aquilae 5 ζ Aquilae	2 .58	
		α Ophiuchi 7 Nova 3 β Ophiuchi	2 .70	
24	0.5	A little brighter than β Cygni	3 .25	(K)Full☽, cloudy
28	1.5	Nova = 72 Ophiuchi	3 .73	
		A little < λ Aquilae	3 .60	3.64 (Y)
"		η Serpentis 5 Nova 5 72 Serpentis	3 .58	
"	"	Nova = θ Serpentis	4 .0	(U)
"	"	η Serpentis 7 Nova 2 θ Serpentis	4 .26	
		λ Aquilae 5 Nova 4 θ Serpentis	4 .08	3.87 (K)
		Nova = δ Aquilae nearly	3 .44	
		Nova 6 θ Serpentis 4 4 Aquilae	3 .69	
29	1.2	η Serpentis 5 Nova 5 β Scuti	3 .96	(Y)
"	"	η Serpentis 5 Nova 5 β Scuti	3 .96	(U)
"	"	Nova 5 θ Serpentis 5 4 Aquilae	3 .95	
		η Serpentis 6 Nova 4 θ Serpentis	4 .07	4.01 (K)
30	0.0	Nova 3 θ Serpentis 4 64 Serpentis	3 .64	(U)
"	"	Nova = η Serpentis	3 .42	
"	0.5	η Serpentis 5 Nova 5 δ Aquilae	3 .43	
		Nova 6 θ Serpentis 4 4 Aquilae	3 .69	
		η Serpentis 3 Nova 7 θ Serpentis	3 .74	3.57 (K)
		Nova < α Scuti (a little)	4 .06	
		A little fainter than λ Aquilae	3 .55	
"	"	= η Serpentis	3 .42	(Y)
July 1	0.0	0^m.2 brighter than η Serpentis	3^m.22	
"	3.0	= λ Aquilae	3 .55	
		= η Serpentis	3 .42	3.35 (Y)
"	5.0	ζ Aquilae 5 Nova 5 η Serpentis	3 .22	
"	3.0	ζ Aquilae 3 Nova 1 η Serpentis	3 .32	(U)
"	"	α Ophiuchi 9 Nova 1 λ Aquilae	3 .40	
		β Ophiuchi 6 Nova 4 72 Ophiuchi	3 .41	
		Nova 3 θ Serpentis 1 4 Aquilae	2 .88	3.23 (K)
		β Ophiuchi 5.5 Nova 4.5 λ Aquilae	3 .28	
"	5.0	ζ Aquilae 4 Nova 6 δ Aquilae	3 .19	
"	7.0	Nova 1 δ Aquilae 2 θ Serpentis	2 .91	(U)
"	23.5	β Ophiuchi 7 Nova 3 ζ Aquilae	3 .00	(K)
2	0.0	= ζ Aquilae	3 .02	
"	0.3	β Ophiuchi 2 Nova 1 η Serpentis	3 .26	3.17 (Y)
"	0.5	ζ Aquilae 5 Nova 5 η Serpentis	3 .22	
"	3.0	γ Aquilae 2 Nova 1 η Serpentis	3 .21	(U)
"	4.30	β Ophiuchi 4 Nova 6 δ Aquilae	3 .14	
		ζ Aquilae 2 Nova 8 δ Aquilae	3 .10	3.12 (K)
		β Ophiuchi 4 Nova 6 η Serpentis	3 .13	
"	23.5	= ζ Aquilae	3 .02	(K)
3	0.0	0^m.1 fainter than ζ Aquilae	3 .12	(Y)
"	"	ζ Aquilae 1 Nova 1 γ Aquilae	2 .91	3.04 (U)
		γ Aquilae 3 Nova 2 η Serpentis	3 .17	

NOTES:—Here the magnitudes of the comparison stars and of the Nova are of the Harvard System; and

(Y) means Dr. I. Yamamoto
(U) " " Y. Ueta
(K) " " K. Kudara
} as the observer.

On the evening of June 14 Drs. Matuyama and Kudara obtained several objective-prism photographs, according to which the hydrogen diffuse series from β to ϵ are very bright upon the far extended (to the violet) continuous background. Every bright line is very broad and somewhat sharply defined on the more refrangible side, where some dark components are suspected. There are two maxima in each of the intervals between Hβ to Hγ and Hγ to Hδ. Dark absorption lines are shown at $\lambda\lambda$ 405, 415, 463 (possibly the dark component of bright λ 464), 501. On this occasion Kudara's visual observations show a very intense Hα-emission.

On June 28, the day of the first minimum magnitude, my objective-prism photographs showed a brighter series of hydrogen lines and λ 464, the dark components being less conspicuous as well as the continuous background. Hα-emission became very wide and developed in my visual impressions. The line λ 4640 was bright and well defined, the appearance and the intensity being almost equal to those of Hγ.

On July 1, I again obtained several prismatic plates. On an Ilford Special Rapid Plate I see a somewhat recovered continuous spectrum, upon which bright hydrogen lines from Hβ to Hζ are impressed, each very broad and Hβ the brightest. There are at least four other bright maxima at $\lambda\lambda$ 420, 440, 464, and 501, of which the third line is peculiarly *wide* and ill-defined on both sides, the intensity being about that of Hδ. On a red sensitive plate of Ilford taken at the same time, I see, besides above, the Hα-line, the brightest, broad and well defined. On the plates of this evening, absorption lines can hardly be seen.

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Kyoto University Observatory,
July 4, 1918.

Parallax of the Andromeda Nebula.—Dr. A. van Maanen has derived the parallax of the Andromeda Nebula from sixteen photographs taken at the 80-foot focus of the 60-inch reflector at the Mount Wilson Observatory, obtaining

$$\pi = + 0''.004 \pm 0''.005$$

Nine comparison stars were used which seemed not to be connected with the nebula. This value of the parallax places the nebula at a distance of 250 parsecs or approximately 5,000,000,000,000,000 miles. Its diameter on this basis would be in the vicinity of 150,000,000,000,000 miles.

Radial Velocity of Nova Aquilae No. 3.—In the October number of the *Publications of the Astronomical Society of the Pacific* Messrs. Adams and Joy give the radial velocity of the new star as — 15 km. This is based upon measurements of the narrow absorption lines H and K upon 14 spectrograms and of D_1 and D_2 upon 5 spectrograms.

Two Stars with Great Radial Velocities.—The two stars Lalande 23995 and Lalande 27274 have been found by Adams and Joy to have unusually large radial veolcities. They have practically the same brightness and spectral type and nearly equal proper motion, but the directions of their motions differ by about 70°.

	α 1900	δ 1900	Mag.	Spec.	μ	φ	V
	h m s	° ′			″	°	
Lal. 23995	12 47 54	−17 56	8.2	F3	0.89	228	+144 km
Lal. 27274	14 54 14	−21 35	8.3	F4	0.80	159	+159

The first is in the constellation Corvus and the second in Libra.

SPICA VIRGINIS

The Star Canopus! Well worth pause to scan it
So distant swung, so regally ashine.
But when from earth irk fain for some far planet
Be splendid Spica mine.

Star so remote nor thought can gage its distance,
Nor science venture, e'en to guess how great;
Its mystery compelling past resistance;
Man's stellar ultimate.

Sublime o'er all the hundred else of Virgo;
Sublime as well o'er all the zodiac;
Without solsticial varying, and, ergo,
With naught of parallax.

My information had from stellar science;
At times a yearn to 'scape from dark and care,
I'd fain bid gravitation's law defiance
And launch me forth for there.

With profitters by thousands out to rope us;
The times all out of joint, the world at war;
Conductive of repose 'yon e'en Canopus—
The utmost visioned star.

ARIES.

Minneapolis Journal, Sept. 13.